TECHNOLOGY

HNOLOGY DEPT.

REVIEW

June 1952

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DETROIT

FLAMINGO APARTMENTS
1220 N. BROAD ST., PHILADELPHIA

Diagrammatic view showing piping arrangement for Webster Tru-Perimeter forced hot water heating. Inset shows basement detail with heat exchangers, pumps and mixing valves for Webster Continuous Flow Controls.

Architect: John H. Graham, A.I.A. Associate Architect: Sweet and Schwartz, A.I.A. General Contractor: Turner Construction Co. Heating Contractor: Benjamin Lessner Co., Inc.

MECHANICAL DESIGN NOTES

Only four risers across entire front of building. Two-zones—one serving floors 2 to 8, the other floors 9 to 15, each with separate Webster CF-2 Control and Outdoor Thermostat. Each zone vented to tank at top of zone – no individual room vents. Two heat exchangers and circulating pumps all interconnected.

Perimeter Heating

For 15-Story Flamingo Apartment Building

Webster Tru-Perimeter Heating with series-connected Webster Walvector and Webster-controlled continuous flow hot water heat provided the designers of this ultra-modern building with comfort heating and attractive interiors without sacrifice of many novel building construction features contributing to low cost. Consider these features:

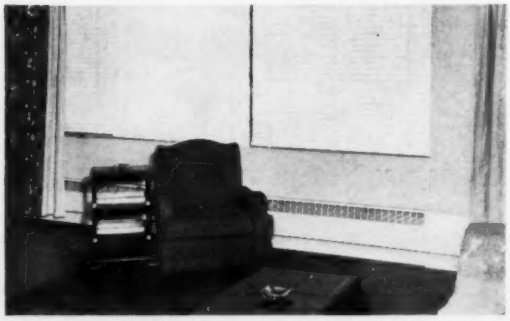
(1) Economy construction. No hung ceiling, no furred columns to conceal piping.

(2) Supply and return risers concealed in partitions at convenient column locations; less than half the risers required in conventional piping.

(3) All connections concealed in continuous Walvector enclosures (see photo), customary runouts completely eliminated.

(4) Neat, attractive, out of the way, matches modern architectural style.

(5) Continuous draft-free, mild heat blanketing the almost all-glass exposure. Water temperature varied automatically with outdoor temperature changes.



Living room in typical apartment showing Webster Walvector.

What is Tru-Perimeter Heating?

Webster Tru-Perimeter Heating uses Webster Walvector, Webster Baseboard, or a combination of both, to replace the heat at the perimeter where heat loss occurs. Heating elements are mounted close to the floor along outside walls, spreading the heat the entire length of the exposed walls.

Webster Tru-Perimeter Heating warms the air within a room, warms the floors and warms the inside surface of outside walls where a normal coolness occurs during winter months. Gently moving warm air is drawn to floor level and across the floor into the inlet opening of the radiation. Radiant heat rays strike the floor along the full length of the exposed wall. Floors are warm and comfortable even with slab floor construction.

Webster Tru-Perimeter results are obtainable with either forced hot water or Moderator controlled low pressure steam heating. For further information about Webster Tru-Perimeter Heating for a new building or modernization see your Webster representative or write us.

Address Dept. TR-6

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In Canada, Darling Brothers, Limited, Montreal

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All but one of the objects in this picture have something in common. They were affected directly or indirectly by the kind of products Norton and Behr-Manning make. ***Can you find the stranger?***

The Shoe Repair Equipment? No! Many operations in a shoe repair shop depend on Norton and Behr-Manning abrasive products. Behr-Manning coated abrasives, for instance, are used to shape and finish heels and soles.

The Submarine? No! Hundreds of its parts depend on Norton or Behr-Manning products. Its camshafts are just one of the many diesel motor parts precision ground by Norton grinding machines and abrasive wheels.

The Greeting Card? No! Norton or Behr-Manning abrasive products are vitally important in manufacturing both paper and printing presses.

Neither Is It the flying wing, the eyeglasses, the washing machine, nor the dentist's equipment.

The stranger in the picture is the bird, which does not rely on man-made products. Remember, any man-made product . . . whether of metal, wood, paper, cloth, leather, ceramics, or plastics . . . depends on abrasives, abrasive products, refractories, or grinding machines that bear such well-known trade-marks as Norton and Behr-Manning . . . world's largest manufacturers of abrasives and abrasive products.

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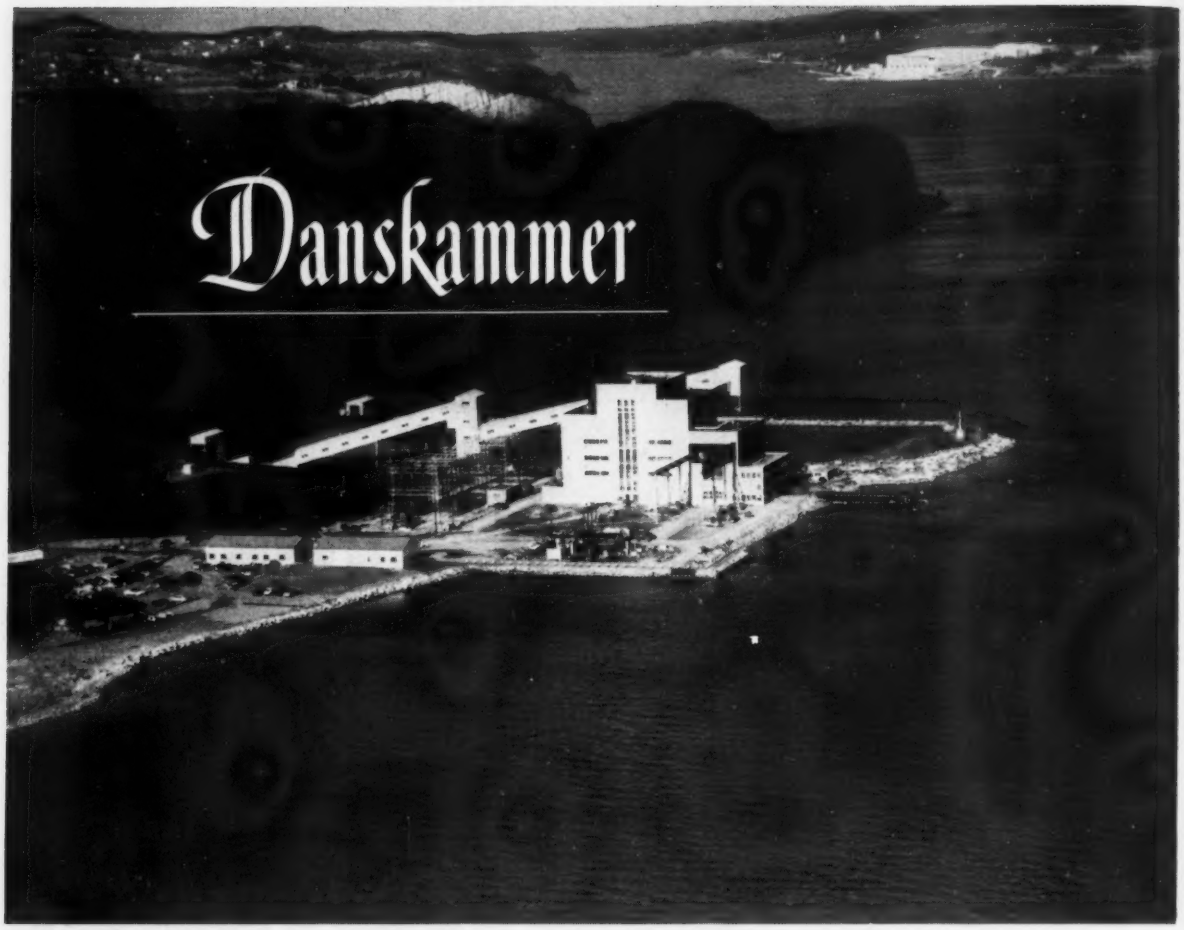
BEHR-CAT BRAND PRESSURE-SENSITIVE TAPES

THE TECHNOLOGY REVIEW, June, 1952, Newsstand Edition, Vol. LIV, No. 8. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription, $4.00. Entered as second-class matter December 23, 1949, at the Post Office at Bristol, Conn., under the Act of March 3, 1879.



"De Duyfels Dans Kammer!" cried one of Henry Hudson's crew as the little Half Moon rounded a bend in the river and approached a large, flat rock on which a band of Indians were holding a ceremonial war dance around a huge fire. It must, indeed, have seemed a "Devil's Dance Chamber". . . and it is still called that today . . . Danskammer.

Last December flames flared again at the Devil's Dance Chamber when a large C-E Boiler was lighted off at the new Danskammer Point power plant of the Central Hudson Gas & Electric Corporation. If Henry Hudson's crew could have looked in on that scene, what a fire they would have witnessed —masses of flames, at temperatures as high as 3000° F., spiralling up through a furnace more than seven stories high.

The starting up of Danskammer was an event of special significance to Combustion Engineering—Superheater because it marked the completion of the Company's 1951 work in so far as *new* utility power stations were concerned. It was the last of nine new stations equipped with C-E Boilers to go into service during the year. The aggregate capacity of these stations, if used only for residential service, would meet the needs of more than fifteen million people. And this is only part of the story, for many more C-E Boilers were installed in 1951 in existing utility stations than in new plants.

C-E Boilers, reflecting the high standards required by modern utility practice, are also available in types and sizes suitable for virtually all heating and industrial requirements.

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Lee Station, Duke Power Company
Contra Costa Steam Plant, Pacific Gas and Electric Company
Hawthorn Station, Kansas City Power & Light Company
Ninemile Point Station, Louisiana Power & Light Company
Edge Moor Station, Delaware Power & Light Company
Palatka Station, Florida Power & Light Company
Johnsonville Station, Tennessee Valley Authority
Danskammer Point Station, Central Hudson Gas & Electric Corporation

B-564

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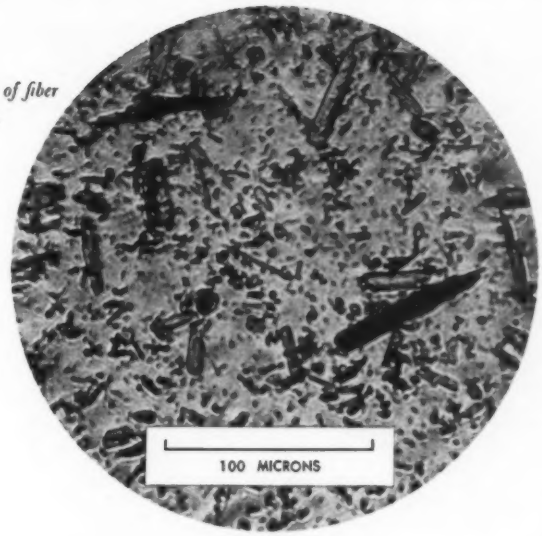
Specialized Employment Division, Dept. 142F
Radio Corporation of America,
30 Rockefeller Plaza,
New York 20, N. Y.

RCA RADIO CORPORATION of AMERICA

The photographs show the range of fiber length obtainable in wollastonite.



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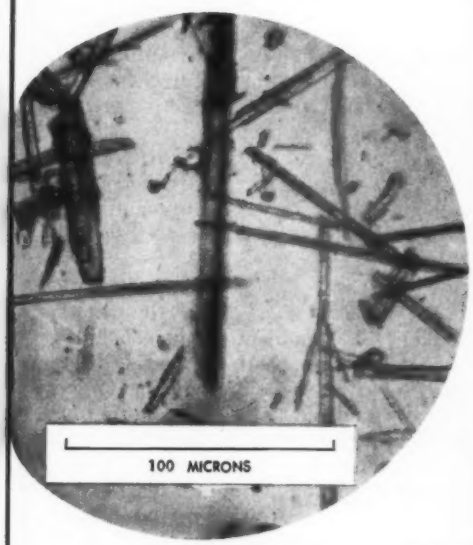

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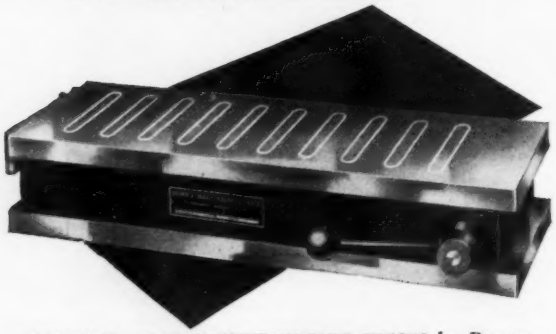

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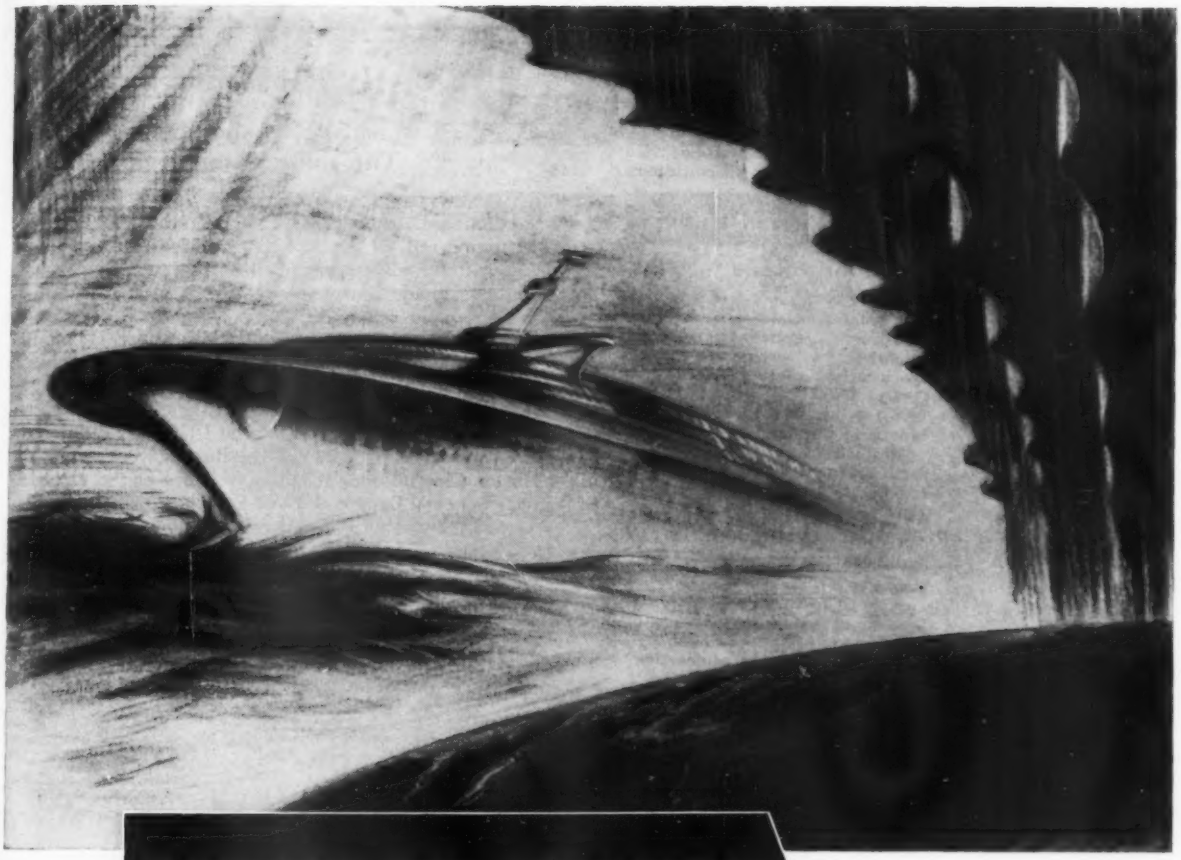
THE TABULAR VIEW

Killian's Millions. — On May 3, 1951, more than 1,000 leading industrialists, educators, and distinguished representatives of the professions gathered at the Waldorf-Astoria Hotel in New York to attend a victory dinner marking the successful completion of the $20,000,000 campaign of the Institute's Development Program. Precisely a year later – with $25,668,532 in the safe custody of Joseph J. Snyder, 2-44, Treasurer – JAMES R. KILLIAN, JR., '26, President, reviews the benefits planned, or already accomplished, as a result of the effective financial assistance which the Institute has received through Alumni, corporations, trusts, and its many loyal friends. President Killian's report to Technology Alumni (page 407) gives ample assurance that "Killian's Millions" have been wisely employed to widen the scope and strengthen the resources of M.I.T. The Institute's educational program has been strengthened, new cooperative relationships have been opened up with industry, additional buildings and facilities have enabled M.I.T. to embark on new and important fields of research, the Institute has made strides toward becoming a residential college, the humanities have been elevated to a fourth School, a fifth School has been brought into being, and cultural activities have been encouraged as never before. The changes wrought at Technology because of the Development Program may well make any Alumnus proud of the auspicious leadership which has been manifest so early in the presidency of Dr. Killian.

Bunker Hill's Quarry Mill. — Eleven decades ago this month, Charlestown celebrated the completion of the Bunker Hill Monument. In the concluding portion of a two-part article, E. H. CAMERON, '13, relates (page 419) how the Yankee granite of Quincy supplied the gray stone blocks for the Charlestown shrine. Mr. Cameron also provides a careful account of progress in the American construction industry when the monument was being built. A vast experience in civil engineering, an extensive personal library on engineering in the post-Civil War period, and a decade as head of the Technical Publications Division of Jackson and Moreland, consulting engineers, enable Mr. Cameron to write with authority.

Seward's Steward. — Co-operation on an international basis is not as new as myopic isolationists might prefer to believe. Indeed, in the Civil War period, Secretary Seward greatly encouraged international cooperation on monetary matters and sent Samuel B. Ruggles to Europe for this purpose, as D. G. BRINTON THOMPSON, '23, reminds us (page 423). Professor Thompson received the A.B. degree from the University of Pennsylvania in 1920, the S.B. degree from M.I.T. in 1923, and the Ph.D. degree from Columbia University in 1945. Between 1924 and 1941 he was in industry, and taught at Lafayette College from 1943 to 1945. Since 1945 he has been at Trinity College, in Hartford, where he is Northam professor of history and chairman of the department.



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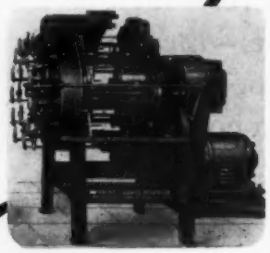
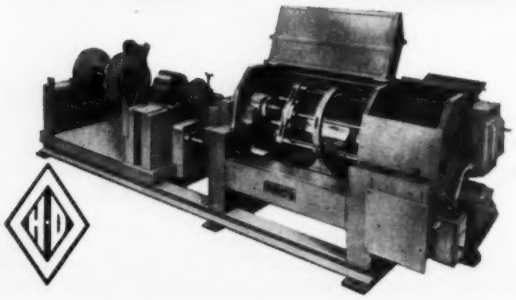




MAIL RETURNS

The *John Mason*

FROM J. NEWELL STEPHENSON, '09:

Mr. Brainerd's article, "Stepbrother to the Iron Horse," which appeared in the March, 1952, issue of The Review, interested me very much. My grandfather, John Stephenson, made that first streetcar. It was called the *John Mason* and, according to the centenary program on the radio in 1932, ran cross-town on 34th Street. He made the first cable cars in New York. He also made coaches, busses, and some railway coaches.

I have grandfather's indenture as a carriage-maker's apprentice. He had his own shop by 1832. His letterhead showed the car on page 241 of The Review.

Hector Clergue once told me the story of the electric railway between Bangor and Veazie, Maine, in the 1880's. It used direct current and cars often stalled on the hill for lack of power until other cars stopped. There were frequent and serious breaks in the water line across the river to Brewer. A professor from Philadelphia found that current leakage from the power plant, which was near the pipe line, was causing electrolytic corrosion. Clergue said this was the discovery of that phenomenon.

Gardenvale, Quebec

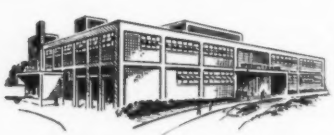
Blow, Wind!

FROM VIKING ENEBUSKE, '15:

Having climbed the Bunker Hill Monument twice, once before I went to Tech and the last time in 1947, I was especially interested in the article "Of Yankee Granite," by E. H. Cameron (May, 1952, Review), and made some calculations of my own, based entirely upon information in The Review, and arrived at a soil pressure of 4.8 tons per square foot, which is within 4 per cent of the figure the author quoted. The thickness of walls and the interior I guessed at for the top and mid-sections.

It is self-evident that the Bunker Hill Monument could only tip over due to soil settlement, even if a hurricane exceeded wind pressures allowed by the Boston Building Code.

Boston, Mass.



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It was designed and manufactured by Phelps Dodge Copper Products Corporation for the U. S. Air Force for installation at the Arnold Engineering Development Center in Tennessee.

Of particular interest is the impervious polyethylene sheath which was selected after a study of all available types because of the protection it provides against contamination during the pulling-in process, its ease of installation and its permanent protection to the cable insulation throughout the operating life of the cable.

Arrangement of testing equipment at the Center required that the main substation receiving the power supply from the transmission system feed four other substations. The feeders had to be underground because continual movement of large jet aircraft under test prohibited the use of overhead lines.

The total circuit length of installation is approximately 8,000 feet. One complete transformation was saved by continuing voltage to substations at incoming supply level. Thus the installation demonstrates again the economy and practicability of transmitting extra high voltage power via the compression cable system.

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THE TECHNOLOGY REVIEW

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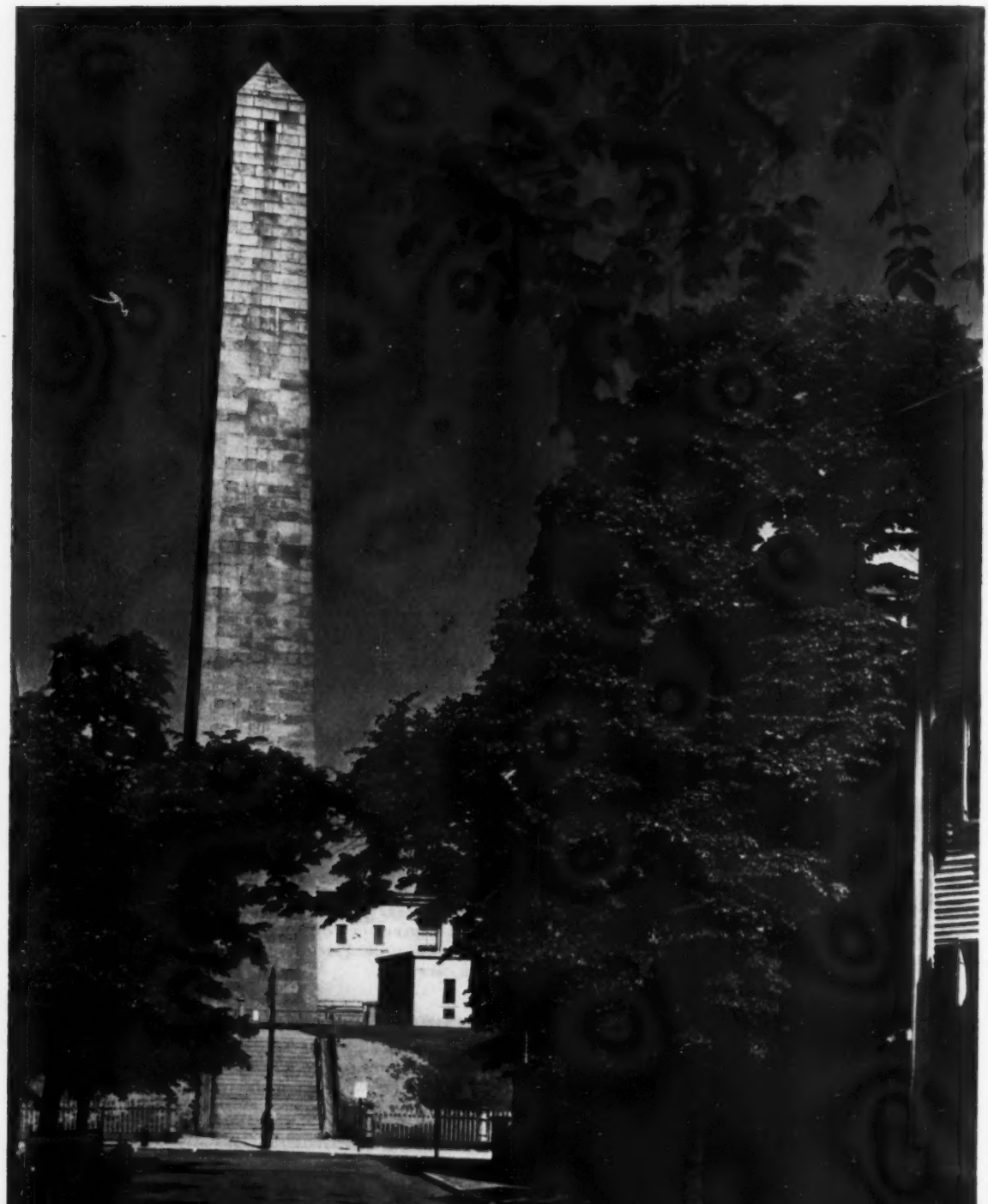


Samuel V. Chamberlain, '18

Today — as 110 years ago when its construction was completed — the Bunker Hill Monument is a symbol of the stern spirit of those who fought in the battle for American independence. The rugged solidity of the monument (described in the article by engineer and writer E. H. Cameron, '13) is reflected in this modern photograph by artist Samuel V. Chamberlain, '18.

THE
THE TECHNOLOGY REVIEW

Vol. 54, No. 8 June, 1952

The Trend of Affairs

Man-Made Mouse

An electrical mouse with a man-made supermemory is busily at work these days, repeatedly threading its way through a series of complicated mazes at the Bell Telephone Laboratories. The handiwork of Claude E. Shannon, '40, the mouse uses for its "brain" some of the same kind of switching relays found in dial telephone systems. The reason it exists, in fact, is to provide fundamental knowledge which will help improve telephone service.

The mouse, in reality a two-inch bar magnet with three wheels and copper whiskers, can quickly solve more than a billion different mazes, learning each new one rapidly, then instantly forgetting it in order to be ready to learn the next one. Its goal, which Dr. Shannon refers to as "a piece of cheese," is really an electrical terminal with a bell which rings when the mouse nudges it with its copper whiskers.

Dr. Shannon has built his maze about half the size of a desk top. It has aluminum fences which can be rearranged at will in 40 different slots to create the hardest possible problems for the mouse. The mouse is placed at some arbitrary point in the maze and the "cheese" at a different arbitrary point. After a brief pause to get its bearings, the mouse goes scuttling up and down corridors, bumping into walls, backing up and turning and exploring until – a minute or two later – it finds the cheese and rings the bell.

Then comes its most interesting performance. Having learned the correct path to the cheese, the mouse can now be set down at any point that it visited during its explorations and, without making a single false move, it will proceed directly to the goal in 12 to 15 seconds. If it is placed in a part of the maze not previously visited, it will explore about until it reaches a known part and then move directly to the cheese.

After this, if the maze is altered, the mouse will have to learn the new paths by further exploration, but it will readily remember those parts of the path which remain unchanged.

When it is set down on the metal floor of the maze, the mouse trips an electric switch which signals its position to a mechanism under the floor. A motor-driven electromagnet moves swiftly to the spot directly beneath the mouse and from then on holds it in a magnetic grasp. The magnet turns through a 90-degree angle, carrying the mouse with it, then guiding it forward. If the mouse hits a barrier and, by means of its copper whiskers, detects that it is in a dead end, the magnet will back away, shift the mouse to another direction, and start it forward to try again to find an open path. The magnet makes successive attempts until it finds the way to the goal. Then it remembers the successful path and can solve the maze directly without error.

To regulate the sequence of movement, Dr. Shannon has built what is called a "programming" circuit, consisting of 40 electrical relays. Another part of the mouse's "brain," which serves as its memory, contains 50 relays. Two small motors complete the equipment.

By working with such problem-solving equipment, Dr. Shannon, who several years ago announced a plan whereby a computer could be made to play chess, hopes to learn more about what man can do with machines. Many of the techniques by which machines are able to remember are being applied in the Bell System in dial switching, automatic accounting, and other equipment. The real significance of this mouse and maze lies in the four rather unusual operations it is able to perform. It has the ability to solve a problem by trial and error means, remember a solution and apply it when necessary at a later date, add new information to the solution already remembered, and forget one solution and learn a new one when the problem is changed.

Dr. Shannon is a graduate of the University of Michigan and holds both a master's and a doctor's

degree from the Institute. He has been with the Bell Laboratories since 1941. In 1940 he won the Alfred Noble Prize of the American Institute of Electrical Engineers, and in 1949 the Institute of Radio Engineers presented him with its annual Morris Liebmann Memorial Prize.

Quiet, Please!

ONE of the fundamental tasks of the scientist working in the field of architectural acoustics is to provide good hearing conditions within lecture rooms, concert halls, and other living spaces. The control and adjustment of the internal acoustical properties of the room form one aspect of this problem. Another is presented by the need, which is usually present, for acoustically isolating the room from unwanted external noises and sound.

The degree of sound reduction secured with most commonly used wall-construction types is chiefly dependent on their weight. As a consequence, economic and structural reasons frequently tend to discourage the utilization of walls which give the appropriate acoustic isolation. Conditions of inadequate acoustic isolation are often found and tolerated in otherwise well-designed and constructed buildings. Particularly in the field of multiple apartment construction, the use of light partition walls is a constant source of annoyance to the occupants, who are, as a result, subjected to the irritating intrusion of sounds from a variety of sources.

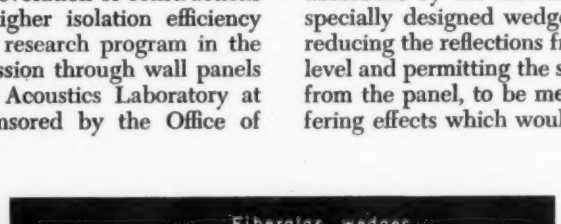
In the belief that a better knowledge of the processes, whereby sound is attenuated by wall structures, may eventually lead to the evolution of constructions and materials having a higher isolation efficiency than is now obtainable, a research program in the problems of sound transmission through wall panels is now in progress in the Acoustics Laboratory at M.I.T. This program, sponsored by the Office of Naval Research, is under the direction of Professor Richard H. Bolt, Director of the Acoustics Laboratory, and Leo L. Beranek, Technical Director of the Acoustics Laboratory, assisted by Albert D. Frost, research assistant in the Department of Physics.

In the past, the insulation values of various wall types have been commonly established by an indirect measurement of the fractional energy transfer between two specially constructed reverberant rooms, acoustically coupled only by a single common wall composed of the material to be tested. A high intensity sound source, such as a group of loudspeakers, is located in one of the rooms. With the aid of several calibrated microphones, located in each room, the average sound levels are determined. From these values and a knowledge of the absorption characteristics of the receiving room, the effect of the panel in attenuating sound incident upon it may be evaluated. This method forms the basis on which most of our present-day performance data on the acoustical insulation properties of walls have been secured. For the theoretical interpretation of the results, it is assumed that a statistically diffuse sound field exists in both rooms; a condition which seldom exists in practice.

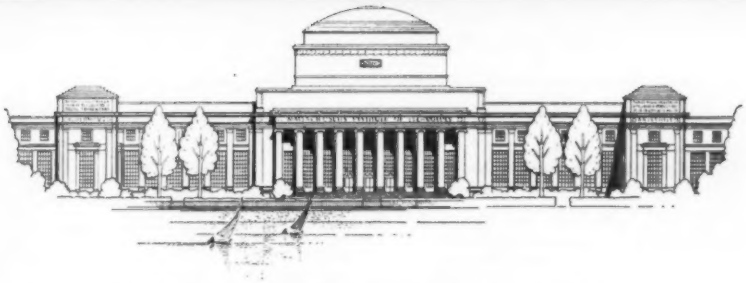
The completion of an anechoic test chamber at the Acoustics Laboratory of M.I.T. makes possible research using new procedures on wall panels up to eight feet square. These present interesting possibilities for securing information of great significance. With the anechoic chamber and better facilities now available, studies are being made on the radiation of sound by wall panels into an anechoic (echo-free) space, when driven by a plane wave. The incident plane wave is simulated by the combined action of 256 electrically identical loud-speakers. The experimental environment can be controlled and specified to a higher degree of precision than is at present possible with reverberation chambers. In addition, it represents a situation that is more tractable from the point of view of the mathematical analysis of the results.

A panel to be tested is placed in an aperture in the foot-thick concrete wall of the test chamber, and the plane wave source sealed behind it. The inner surfaces of the test chamber have been made highly absorbent by the installation of a large number of specially designed wedges. These have the effect of reducing the reflections from the walls to a negligible level and permitting the sound field, radiated directly from the panel, to be measured without those interfering effects which would arise if internal reflection were permitted to exist. Using a microphone in a carriage remotely positioned outside of the chamber, it is possible to measure and record the amplitude and relative phase of the sound field at any desired point behind the test panel. From the radiation pattern so obtained, it is hoped that a more meaningful evaluation of panel. From the radia- derived and, in addition, an insight be gained into the basic factors which control the mechanism of sound absorption in walls.

This basic study of the transmission of sound makes its contributions to less noisy homes and offices.



Floor plan of anechoic chamber in which the transmission of sound through panels is studied. The test panel is supported at the left of the soundproof room.



Funding M.I.T.'s Future

A Review of the Accomplishments of the $20,000,000 Drive

By JAMES R. KILLIAN, JR.

M.I.T. emerged from World War II with a new sense of mission. No one familiar with its wartime history could have failed to agree with President Compton that the war record of M.I.T. "dramatically spotlighted the importance of an institution of this kind to industry, to government, and to the national welfare generally." The Institute's wartime contribution as a great research center was, perhaps, not unexpected. Its contribution in furnishing leadership in the war effort indicated a significant change in the kind of responsibility which the engineer and scientist must now assume. At the same time, the technological opportunities opened up during the war had made it imperative that new equipment and facilities be provided if M.I.T. were to maintain its place of leadership as a technological institution.

It was a "time of decision" for the Institute. It was a time for careful but bold planning. In the early postwar years the Executive Committee of the Corporation initiated a survey of the Institute's most pressing needs. These needs, in turn, depended to a large extent on the Institute's educational program, and it was evident that this, too, called for a reassessment. In January of 1947 the Faculty appointed the Committee on Educational Survey to review the educational objectives of the Institute. This committee spent two years on its study. Meanwhile, a Survey Committee was established by the Corporation to determine M.I.T.'s financial requirements and recommend ways of meeting them.

Two important conclusions emerged from these studies and discussions:

1. That the Institute should keep its student body limited in size, although larger than prewar, and offer a quality education, both undergraduate and graduate, to those young people best prepared to benefit from it – an education which would combine superb professional experience with the best possible general education. This was a reaffirmation of M.I.T.'s long-standing educational philosophy.

2. That the Institute should and could obtain greatly increased support from private sources, including individuals, foundations, and industry, and that the solicitation of this support required a large-scale and sustained effort.

Together, these decisions represented an act of faith. It was an expression of our belief that the educational ideals of democracy would still command impressive support; that the people of this country would respond to the need for providing its most gifted young people in the fields of science and engineering with the educational facilities which would enable them to develop their full powers. It expressed our belief that American industrialists and businessmen were prepared to help provide successors for themselves who could keep our progress as a nation commensurate with our opportunities as the foremost industrial democracy of the world.

This faith has been more than justified by the results of our Development Fund Drive.

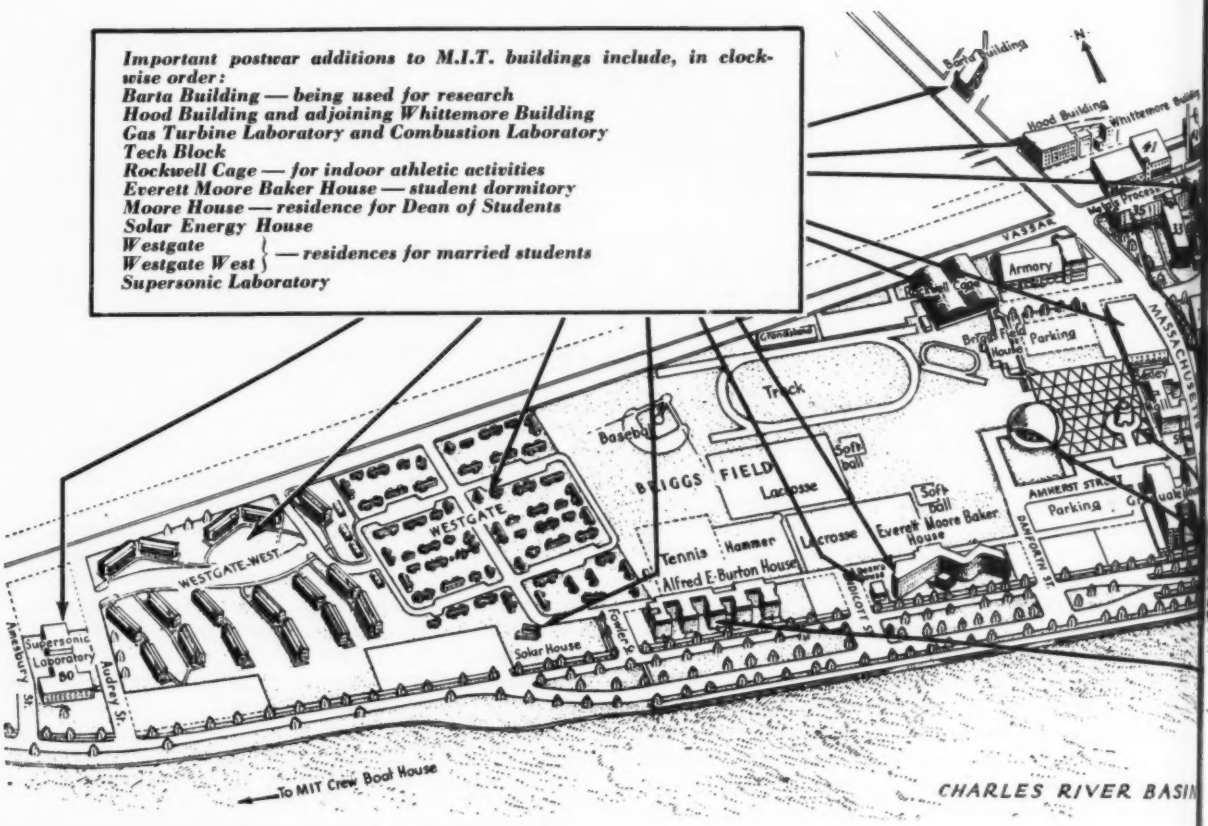
New Friends and New Finances

Between January 1, 1948, and June 30, 1951, the period of our intensive Development Fund Drive, 10,632 individuals (8 per cent non-alumni), 266 corporations, and 34 foundations made contributions to M.I.T. The amount contributed or pledged in this period was $25,668,532. Approximately 26 per cent of this total was from corporations, 24 per cent from individuals, and 50 per cent from foundations and other sources.

This is an impressive record. It is even more impressive when it is remembered that this, the intensive phase of the postwar fund-raising program, followed upon the receipt by M.I.T. of some $7,750,000 in new financial support in the first two and one half years after the end of World War II. Except for the Eastman gifts, this amount is significantly larger than had been received in any comparable period of time theretofore.

Major additions to funds during the years 1945 through 1947, included the following:

Amount	*Donor*	*Purpose*
$2,200,000	Charles Hayden Foundation	Library—Humanities Center
750,000	Alfred P. Sloan, Jr., '95 General Electric Company Westinghouse Electric Corporation United Aircraft Corporation Curtiss-Wright Corporation General Machinery Corporation	Gas Turbine Laboratory—Enlarged Automotive Laboratory
500,000	M.I.T. Alumni Fund	Senior Dormitory



Major gifts received during the Development Fund Drive conducted by the Committee on Financing Development included:

Amount	*Donor*	*Purpose*
$5,250,000	Alfred P. Sloan Foundation, Inc.	School of Industrial Management
1,500,000	Kresge Foundation	Auditorium—Chapel
1,000,000	John D. Rockefeller, Jr.	Unrestricted Funds*
1,000,000	Campbell Soup Company	John Thompson Dorrance Laboratory of Biology and Food Technology
1,000,000	Alfred P. Sloan Foundation, Inc.	Metals Processing Laboratory

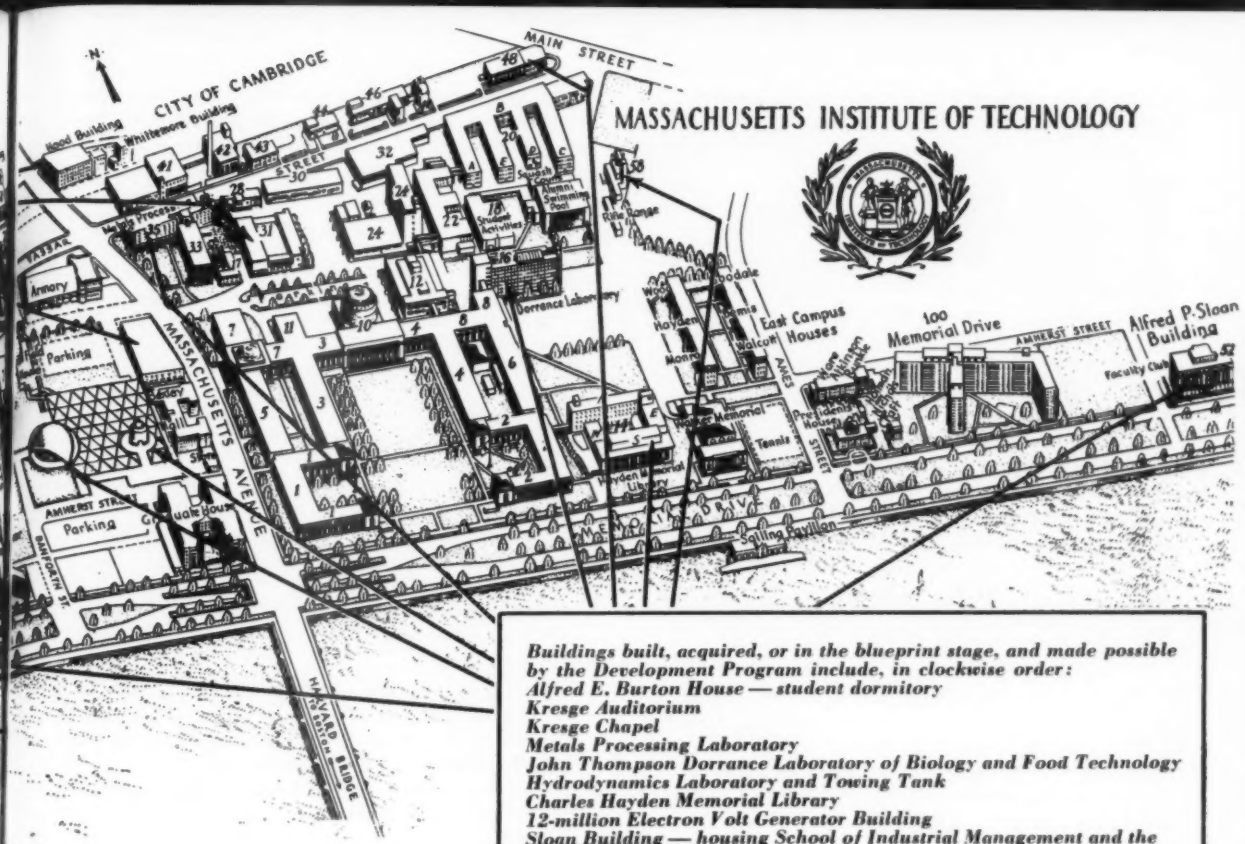
More than $4,500,000 of the total subscribed by corporations was in the form of major grants, of the order of $250,000 over a period of five years. Such corporate contributions were made in general support of education and research in the field or fields of a company's interest. Except for something over $180,000, which went toward the capital cost of a building for a 12-million electron-volt (12 M.E.V.) generator, these grants were used for current operations. Companies making such substantial grants did so under an arrangement whereby the Institute, through its Industrial Liaison Office, undertakes to keep these firms systematically informed about research and educational activities at M.I.T. which are important to their business.

* This gift was to augment the Institute's unrestricted funds so that it might, in the words of Mr. Rockefeller, "continue to expand its strategic service to all interested in the advancement of science for the betterment of mankind, irrespective of national boundaries."

New Level of Teamwork

A report on what the Development Program has meant to M.I.T. may well begin with a report on the intangibles. More important than any particular accomplishments, either in new buildings or new programs, have been the vigor, enthusiasm, and sense of mission with which all members of the M.I.T. family have tackled the job of helping the Institute to embrace fully its present challenging opportunities. There has been a mobilization and a massing of forces that have given us a wholly new concept of the strength of M.I.T. Moreover, there has been a very real feeling that it is not only as Alumni and staff that we are joined to insure and enlarge the usefulness of M.I.T., but as citizens concerned with strengthening what has proved to be a tremendous national asset.

To the Institute's Alumni this country now owes a debt beyond measure. Under the inspiring and inspired leadership of Alfred P. Sloan, Jr., '95, and Marshall B. Dalton, '15, honorary chairman and chairman, respectively, of the Committee on Financing Development (C.F.D.), Alumni throughout the country have given unsparingly of time and effort as well as money to make the Development Program a success. The 700 Alumni who participated as members



Buildings built, acquired, or in the blueprint stage, and made possible by the Development Program include, in clockwise order:
Alfred E. Burton House — student dormitory
Kresge Auditorium
Kresge Chapel
Metals Processing Laboratory
John Thompson Dorrance Laboratory of Biology and Food Technology
Hydrodynamics Laboratory and Towing Tank
Charles Hayden Memorial Library
12-million Electron Volt Generator Building
Sloan Building — housing School of Industrial Management and the Faculty Club

of the Committee on Financing Development will take an honored place in the records of the Institute. These men spearheaded the drives in the local communities and provided the necessary liaison between the Institute and its far-flung family. Particular tribute is due to the Alumni who headed the major committees and the eight regional offices, the members of these committees, and the countless others who became associated with them in helping to make this fund-raising campaign a success. As the fulcrum of the effort, the very able staff in the Development Office at the Institute contributed magnificently. This staff included: Professor William L. Campbell, '15, Executive Director; Ralph T. Jope, '28, Assistant Executive Director (now Director of the permanent Development Program Office), and L. Francis Lybarger, Jr., of Marts and Lundy, Resident Director.

The intensive drive for new funds from without the Institute was matched within the Institute by the intensive drive to bring each part of our program into line with the new postwar goals. The Institute has a proud tradition of co-operation among Administration, Faculty, and students. There is nothing new in reporting the devotion of this splendid group. But during this period, when extraordinary creative activity in respect to the over-all program was called for, there was a new surge of effective teamwork. Moreover, the Development Program served to keep before all of us the common purposes that unite our various activities. As the reports flowed in, of the activity of Alumni and friends in seeking to strengthen our financial support, there was no doubt in the writer's

Committee on Financing Development

Committee Chairmen

Corporation Survey Committee	John R. Macomber, '97
Steering Committee	Marshall B. Dalton, '15
Committee on Alumni Participation	H. B. Richmond, '14
Committee on Bequests	Phillips Ketchum
Committee on Business Corporations	Robert T. Haslam, '11 Paul Ryan, '22
Committee on Foundations	Frank B. Jewett, '03 (deceased, 1949) Richard P. Windisch, '21
Committee on Projects	William L. Campbell, '15
Committee on Public Information	Thomas D. Brophy, '16
Committee on Resources	Horace S. Ford
Committee on Special Gifts	Gerard Swope, '95 (honorary) B. Edwin Hutchinson, '09
Committee on Special Trusts	Royal Little

Regional Chairmen

Region I	Raymond Stevens, '17
Region II	Duncan R. Linsley, '22
Region III	Walter J. Beadle, '17
Region IV	Paul W. Litchfield, '96
Region V	Louis H. G. Bouscaren, '04
Region VI	Horace R. Bennett, '16
Region VII	Samuel W. Selfridge, '13 H. W. McCurdy, '22 William L. Stewart, Jr., '23
Region VIII	William E. Mitchell, '03 James F. Crist, '24

mind that the program renewed in each of us at the Institute the determination to put our very best effort into making the college program justify the expectations of its friends.

New Resources; New Opportunities

A new M.I.T., widened in scope and strengthened in resources, has emerged as a result of the financial support furnished by the Development Fund Drive and the vigorous activity within the college community. It is an M.I.T. more conscious than ever before of its national and international status. The Institute has a new vision of its educational responsibility as we enter an age in which men with scientific background are increasingly in demand, not only as specialists, but for managerial and policy-making positions. It is devoted, as it always has been, to combining professional and general education at the undergraduate level, but with a new concept of the way in which all parts of the undergraduate program can be made to contribute in full measure to a man's preparation for his postgraduate responsibilities.

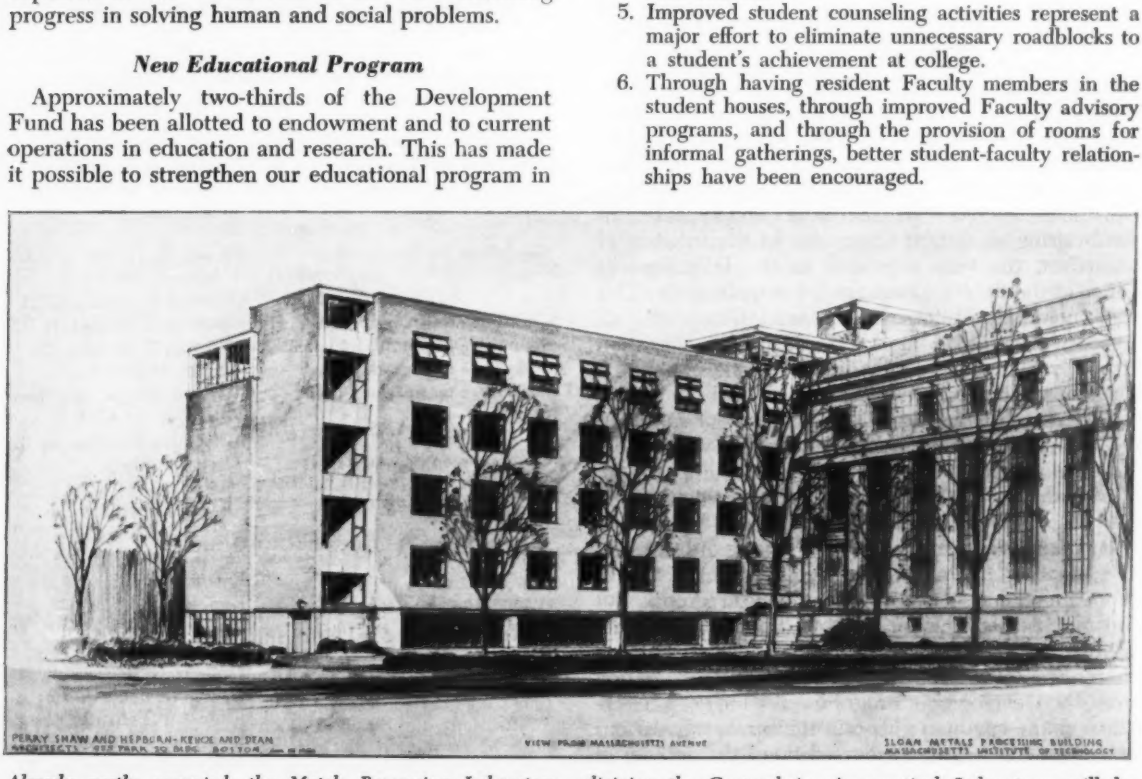
It is an M.I.T. responsive to the demands of a period of unprecedented industrial activity. The acute shortage of highly qualified scientists obliges the Institute further to strengthen its Graduate School. Moreover, since the current defense program inevitably draws scientists and engineers away from basic research into development work, it is more than ever important that a great technological institution rededicate itself to its primary research responsibility, that it provide the atmosphere and the incentives for the fundamental explorations that alone can insure our continuing progress in solving human and social problems.

New Educational Program

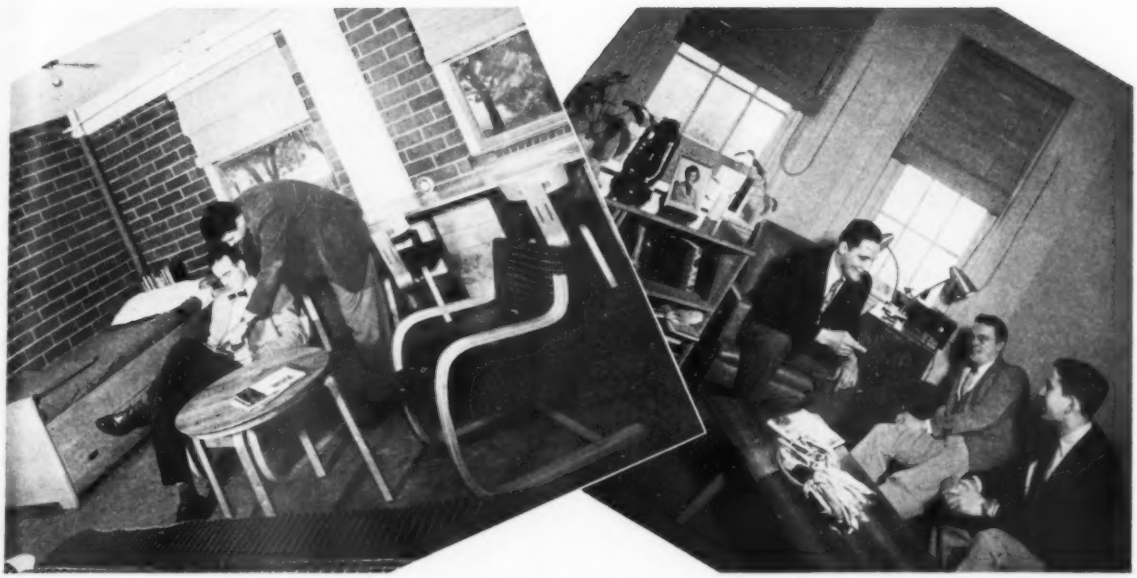
Approximately two-thirds of the Development Fund has been allotted to endowment and to current operations in education and research. This has made it possible to strengthen our educational program in many ways. Most notably, I believe we have been successful in finding expression for a concept of "education in the round," by which I mean creating at the Institute a situation where every aspect of life contributes to the development of the professional man.

Specifically, the educational program has been strengthened as follows:

1. A new School of Industrial Management has been established which will enable the Institute to exploit fully its opportunity to train graduates with a scientific background who are prepared for management responsibility. It will also make possible pioneering contributions to the developing art and science of management.
2. A School of Humanities and Social Studies has replaced the former Division of Humanities. By expanding its participation in the social sciences, the Institute has been able to strengthen greatly the content of the undergraduate curriculum in these fields. In addition, the Institute can offer opportunities for creative work on problems caused by the impact of science on our society, and on questions of how better to use our scientific knowledge in the solution of social problems.
3. Professional courses have been redesigned, where necessary, to emphasize fundamental principles and to develop powers of judgment. New programs have been initiated which will encourage creative work at all levels of undergraduate work.
4. M.I.T. has become a residential college and is developing an environment for its students which, in itself, performs an educational function. Expanded student-government activities have increased the opportunities for students to learn to take responsibility and exercise judgment in handling affairs of common concern.
5. Improved student counseling activities represent a major effort to eliminate unnecessary roadblocks to a student's achievement at college.
6. Through having resident Faculty members in the student houses, through improved Faculty advisory programs, and through the provision of rooms for informal gatherings, better student-faculty relationships have been encouraged.


PERRY SHAW AND HEPBURN-KENDE AND DEAN
VIEW FROM MASSACHUSETTS AVENUE
SLOAN METALS PROCESSING BUILDING
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Already partly occupied, the Metals Processing Laboratory, adjoining the Guggenheim Aeronautical Laboratory, will be dedicated on June 3.



The Development Program has made possible substantial increases in student residences, thus aiding the Institute to become a residential college. Shown here are views of typical rooms in Baker House (left), *and Burton House* (right).

In addition, the educational program has been strengthened by the improvement in facilities which the Development Fund Drive has made possible, as well as by the closer relationship between M.I.T. and the industrial community.

New Relationship with Industry

One of the happiest results of the Development Program has been the closer relationship which M.I.T. has now established with industry. In the course of the Development Fund campaign, members of the Institute's Administration met and talked with industrialists throughout the country to an extent that, regretttably, is not always possible in the normal course of events. Coming as it did at a time of growing management concern with the work and needs of the technological schools, the Development Fund Drive provided an opportunity for an exchange of understanding of each other's needs, which was welcomed by the Institute and industry alike.

The Industrial Liaison Office was established by the Institute in 1948 to centralize all Institute contacts with the companies which give major support to work in fields of their interest, and will serve to keep this relationship a continuing one. Through this office we have developed a systematic way of keeping in touch with an important cross section of the industrial community. To the Institute's program, and to industry generally, such liaison yields benefits that extend beyond the immediate and primary purpose of serving particular concerns.

The success of the industrial liaison program is attested by the fact that it is rapidly expanding. It promises to become ever more important as, increasingly, large industrial concerns discover the need for keeping in touch with scientific progress in all fields. At the same time, the program provides industry with an appropriate channel for giving support to the basic research which will help insure that solutions will be found for new problems as they arise.

The Development Fund Drive owes much of its success to corporate gifts and to industrial support of the Ins'itute's research and educational programs. In a major way, this type of support has helped M.I.T. to keep abreast of the requirements of a period of intense industrial activity and scientific advance. There is no doubt but that M.I.T.'s continued ability to meet the needs of our day will depend in large part on the interest and support of the business and industrial community.

New Buildings and Facilities

A technological institution must keep abreast of scientific advance in its facilities and equipment, as well as caring for the normal continuing building requirements of any first-rate educational institution. Even before the war the need for new facilities was urgent. By the close of the war the need was imperative.

– The steady progress of science and engineering posed demands for extremely complex and expensive research and teaching tools, and had made obsolete much prewar equipment.

– M.I.T. lacked the dormitories and other student buildings so important to a rounded educational environment.

– Its library facilities were outgrown. It had no auditorium. It had no chapel.

– There were appropriate new programs for M.I.T. to develop if facilities and men could be obtained; for example, metals processing, industrial management, nuclear engineering, the life sciences.

– Enrollment would be higher than prewar, and this posed its own requirements for additional space. M.I.T. had to assume its share in meeting the national shortage of scientists and engineers.

– Even before Korea it was apparent that M.I.T. had an obligation to extend its services to government and to industry.

English and History reading room in the new Charles Hayden Memorial Library provides pleasant surroundings for study.

First steps to bring our plant up to date were taken almost as the Japanese surrender was signed. A major purpose of the Development Fund Drive was to carry forward the Institute's postwar building program. More than one-third of the Development Fund was allotted for building purposes, either through designation by the donor or through allocation of undesignated funds for this purpose by the Executive Committee of the Institute.

The John Thompson Dorrance Laboratory of Biology and Food Technology is now under construction. Named in honor of a distinguished alumnus of the Class of 1895, who was also founder and first president of the Campbell Soup Company, this laboratory was made possible by the $1,000,000 gift of this company, and by an additional allocation of $1,500,000 from the Development Fund. Costs before completion of this exceptionally fine new building are expected to exceed $3,000,000. The laboratory will have seven floors, a basement, and penthouses, and will provide, in all, about 100,000 square feet of gross area. It is planned that the Department of Food Technology will occupy the lower floors and the Department of Biology the upper ones.

The purchase of Lever House, which occupied land adjoining the Institute's grounds, has furnished M.I.T. with a splendid building for its new School of Industrial Management. In addition, the sixth floor and penthouse will be used for the long-awaited Faculty Club. Now renamed the Sloan Building, it blends architecturally with other Institute buildings and is admirably adaptable to educational use.

On Memorial Drive, the Sloan Building marks the eastern terminus of Technology buildings. The Sloan Building will house the School of Industrial Management and the Faculty Club.

The capital cost of the Sloan Building, $2,504,000, was substantially covered by using, for this purpose, almost one half of the Alfred P. Sloan Foundation gift for the School of Industrial Management.

An additional $100,000 from the Development Program funds will help cover the costs of remodeling the floors to be used for the new quarters of the Faculty Club in the Sloan Building.

The Metals Processing Laboratory, which is expected to be ready for use by early summer, will permit M.I.T. to consolidate its educational activities involving both metallurgy and mechanical engineering. At the Institute we have been developing a program in which metallurgical science and the mechanics of materials have been applied to the basic processes of machining, finishing, casting, forging, welding, and related techniques. Traditionally there has been no integrated treatment of metals processing in educational institutions. The new Metals Processing Laboratory, made possible by a gift of $1,000,000 from the Alfred P. Sloan Foundation, will provide space and facilities commensurate with the importance of the work done in this field.

The Kresge Foundation grant of $1,500,000 to the Development Program has made it possible for the Institute to move ahead with plans for an auditorium and chapel, and $1,250,000 has already been allocated for building purposes. Eero Saarinen, who has been associated with the design of such beautiful and functional buildings as the Berkshire Music Center (Tanglewood) and the Art Center and Museum of Des Moines, Iowa, has completed plans for an auditorium which express the fresh and creative ideas which have become synonymous with the Institute itself. The auditorium will seat 1,200 and has a stage which will accommodate the largest Institute choral groups, as well as the symphony orchestra. The basement is so planned that it can be developed as a small theater and auditorium to meet the special requirements of our drama groups.

It is also planned to build, adjacent to the auditorium and in a complementary relationship to it, a small nondenominational chapel which will seat 125 persons. The Dean of Students is developing plans for the use of the auditorium and chapel which will insure their full contribution to the rounded educational program which is being evolved at M.I.T. Construction of the auditorium and chapel will start as soon as the availability of building materials permits.

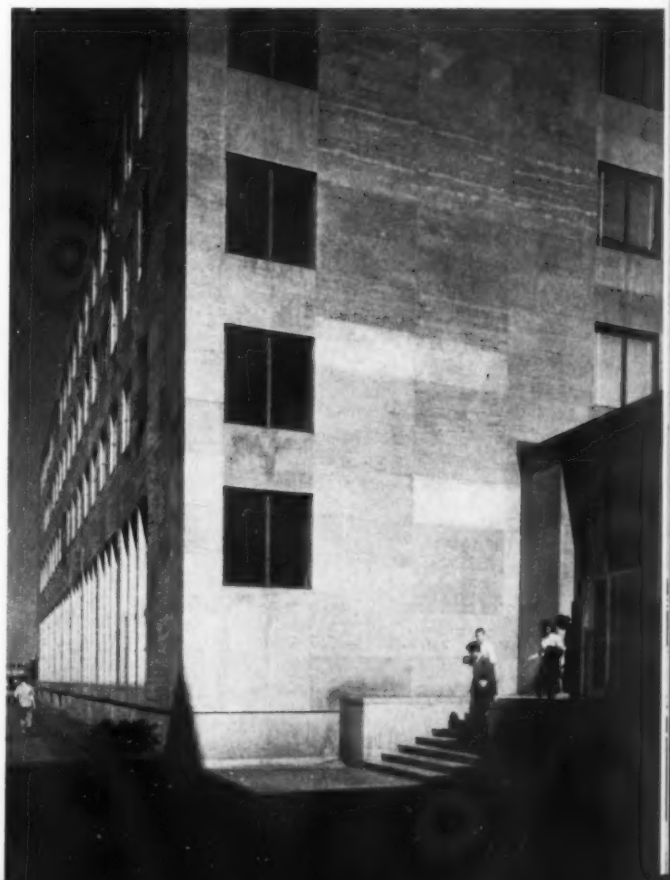
The Charles Hayden Memorial Library was dedicated in May, 1950, its completion having been aided by $1,189,824 from the Development Fund. It stands almost as a symbol of the M.I.T. of the Mid-Twentieth Century. It houses our Central Library as well as the School of Humanities and Social Studies, an open-shelf library and reading room on English and History, a music room and library, a map room, an art gallery, and a consolidated science library (now replacing the Dewey Library which is being moved to the Sloan Building). A spacious lounge on one of the upper floors has provided an appropriate place for visitors to lecture informally in an atmosphere conducive to discussion. The music library provides recorded concerts daily, and the music rooms are always crowded — the most eloquent possible testimony that students and staff appreciate the enrichment of campus life which the library has made possible.

Another building completed during the Development Fund campaign, and to which some of the Development Fund was allotted, is the Hydrodynamics Laboratory and Towing Tank. This new laboratory, which was built at a cost of $635,000, has provided exceptionally fine instructional and research facilities for fluid mechanics. It has provided — for the first time on the East Coast — an adequate hydraulics laboratory in this field, of interest to both industry and government. It gives the Institute an adequate towing tank.

The Development Fund contributed, too, to the building of the 12,000,000 electron volt electrostatic generator, which will enable M.I.T. to carry forward its pioneering work in the development of electrostatic direct-current generators built on the Van de Graaff principle. This facility, designed primarily for fundamental studies of the nucleus, will allow further explorations of the use of cathode rays for sterilization. The high-voltage laboratory works closely with the Department of Food Technology in studies of the commercial possibilities of the electron sterilization of foods. In association with medical personnel in the community, it has made dramatic contributions to medical and surgical science. The new generator will make possible further advances. Built at a cost of $278,255, this splendid research facility obtained more than $180,000 from the Development Fund towards its completion.

The small portion of the Development Fund which was allocated to the dormitory program fails to indicate the extent to which the Development Fund Drive contributed to the postwar transformation of M.I.T.

The corridor, extreme right, connects the Charles Hayden Memorial Library with the main group of academic buildings at M.I.T.



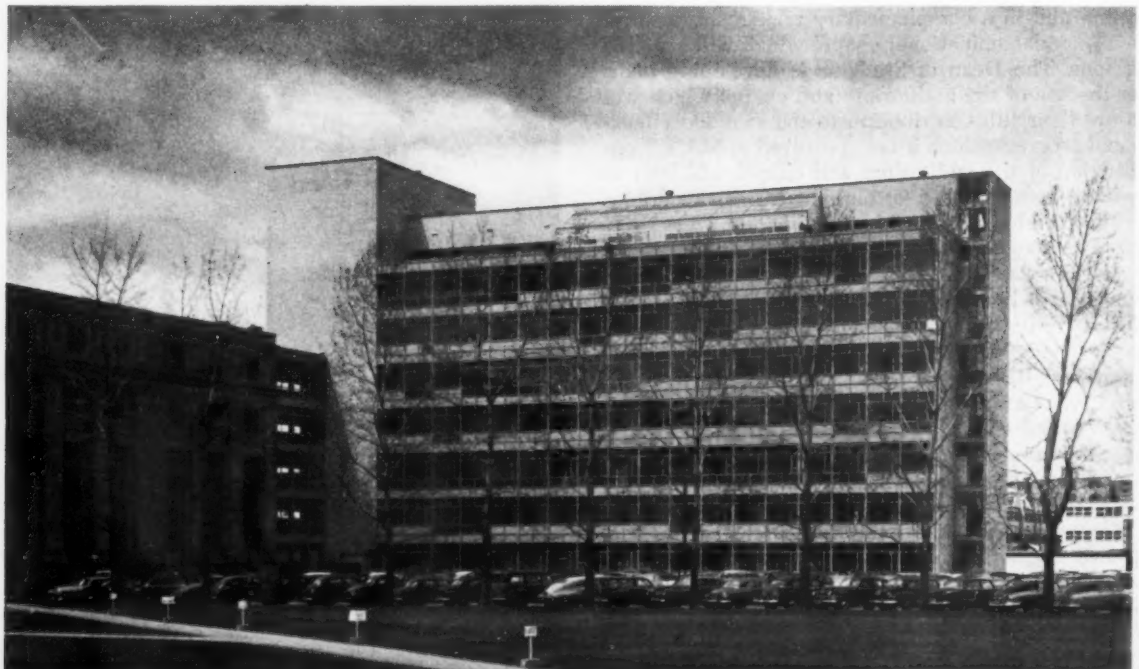
This modern building, of unusual shape, houses the 12 M.E.V. Van de Graaff generator used in studies for nuclear research.

into a residential college. Without the assurance that a major campaign for funds would be successful, the Administration would not have felt free to invest such a large portion of Institute funds in student housing, urgent as it felt the need to be. However, with the Development Fund campaign in progress, it became possible after the completion of the senior dormitory (Baker House) in 1949, to purchase the Riverside Apartment Hotel for use as another dormitory. This new housing facility has been named Burton House.

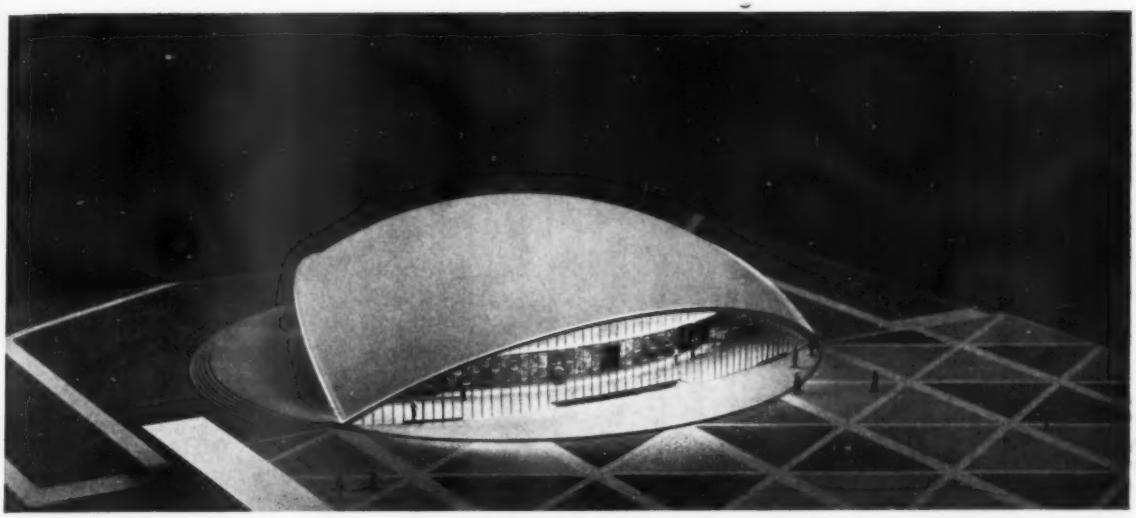
These two additions gave us nearly 1,000 new accommodations for students and more than doubled our permanent dormitory facilities in the course of one year. If we include Westgate and Westgate West (the units for married students provided since World War II), and the fraternity houses, we have accommodations now for approximately two-thirds of our student body. Few achievements since the war have been so welcome. The Institute has also received by bequest a residence for the Dean of Students. The former home of the late Professor Forris Jewett Moore at 372 Memorial Drive, next door to Baker House, became the property of the Institute on the death of Professor Moore's widow in 1950, and has been occupied by E. Francis Bowditch, Dean of Students, and Mrs. Bowditch since their arrival at M.I.T.

Between the end of World War II and June, 1951, the Institute had constructed (or started the construction of) more than 1,000,000 square feet of space. This represents an increase of approximately 50 per cent in the size of our plant. In addition to the facilities provided by the Development Fund, a Supersonic Wind Tunnel, a Gas Turbine Laboratory, and a Combustion Laboratory have been built since the war's end. Rockwell Cage, built in 1948, has provided the Institute for the first time with an adequate undercover area for sports such as baseball and lacrosse. In addition, M.I.T. has expanded its facilities for research through purchase of the Barta Building and the Whittemore Building, just north of the campus, both on Massachusetts Avenue. Both of these properties were bought for investment purposes, but are now used for sponsored research.

Still other pieces of property have been acquired by the Institute as investment properties, including the Tech Block on Massachusetts Avenue across from



Skyscraper of the M.I.T. buildings is the Dorrance Laboratory which will be ready for occupancy in the fall of 1952.



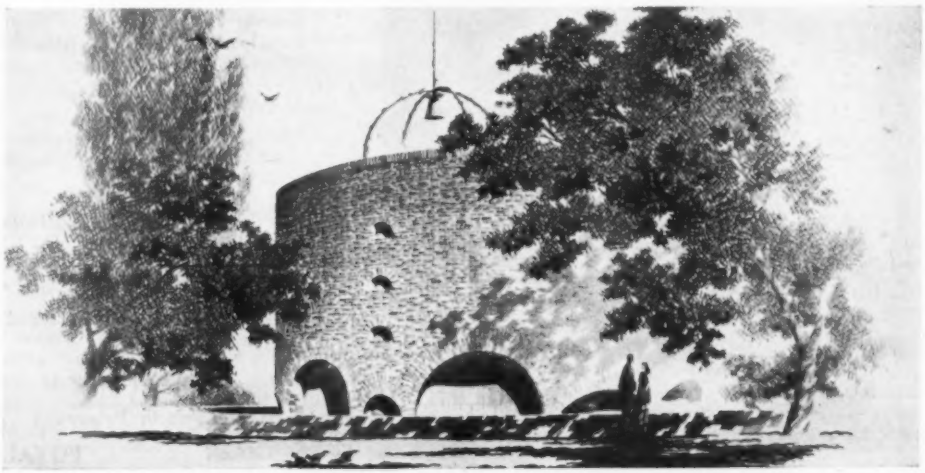
Among the buildings made possible by the success of the Development Program is the projected Kresge Auditorium. Shown here is the conception of Eero Saarinen, architect for the auditorium.

our main buildings. We are presently exploring with city and state authorities the possibilities for a Massachusetts Avenue underpass between the East and West campuses, so that in the not too distant future we may hope to have a broad plaza between the Rogers Building on the East Campus and the new auditorium on the West Campus.

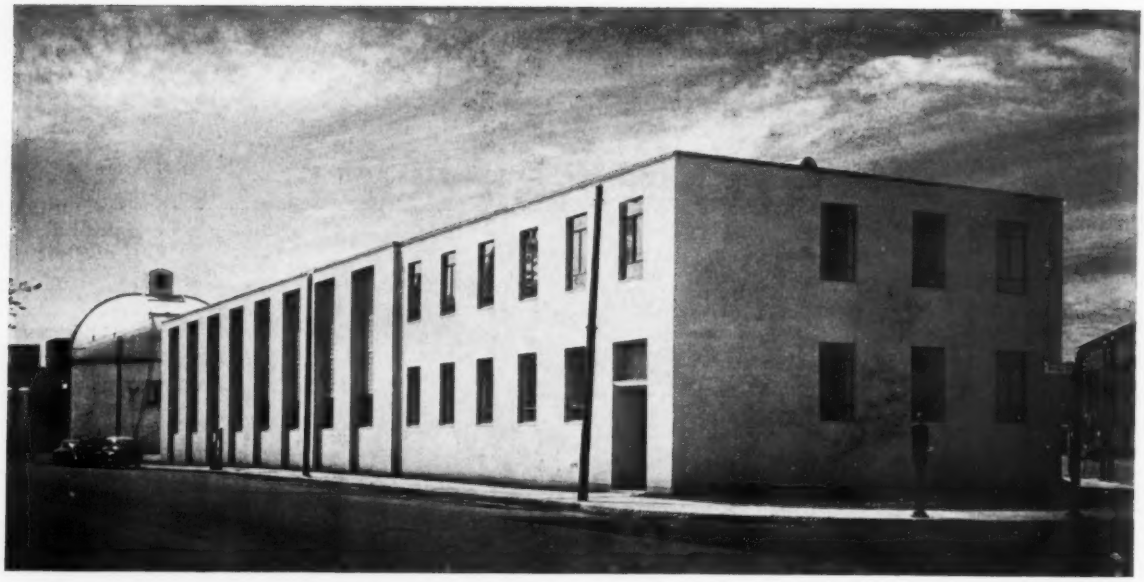
Capital Funds

When the Development Fund Drive was planned, it was hoped that this campaign would enable us to increase our capital funds by $10,000,000, of which $8,000,000 would be set aside for endowment. This amount was considered as a minimum requirement to finance badly needed salary increases and scholarships, to strengthen our program in the humanities and to increase the Institute's endowment income which had dropped to a dangerously low level in relation to the magnitude of its operations. As it turned out, we were able to allot only $4,464,547 of the Development Fund Drive receipts to permanent capital funds. Thus, only half of our goal in this important area was obtained. Over $2,000,000 of the increase has been allocated to endowment for designated purposes. This includes $500,000 set aside for the Faculty salary reserve and approximately $700,000 for scholarships.

Since the need for new endowment and unrestricted funds is a continuing one, the failure of the Development Fund Drive to carry us over the top on this objective is more serious than it otherwise might be. Moreover, just as rising costs have affected the progress of the building program, so too, have they made it necessary for the Institute to lift its sights in respect to the endowment it must continue to seek. One of the benefits we expected to derive from the intensive Development Fund campaign was an increase in the annual gifts received by the Institute once the drive was completed. This hope has been realized this year, with total gifts probably exceeding $5,000,000, exclusive of maturing pledges to the Development Fund. As a result, this year we will add more than $2,000,000 to our endowment.



Architect's drawing of the exterior of the Kresge Chapel which will be built as soon as construction materials become available for this purpose.

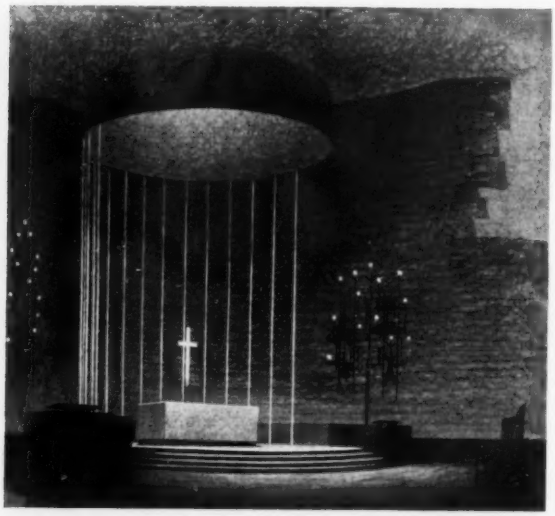


The Hydrodynamics Laboratory and Towing Tank at M.I.T. was dedicated last June. The buildings and equipment were described in the June, 1951, issue of The Review.

Allocation of Funds

The statement of objectives of the $20,000,000 drive did not include any item for current operations. However, at the start of the drive the Executive Committee of the Corporation asked that practically all contributions of any kind made to the Institute during the campaign should be counted toward the total. The total amount reported, therefore, includes gifts and grants given during the period for current operations, as well as those given specifically for the objectives of the campaign.

The following table summarizes the allocation of funds subscribed to the Development Program during the Development Fund Drive, January 1, 1948, to June 30, 1951:



Architect's rendition of the interior of the nondenominational Kresge Chapel planned for the future. This cultural addition to Institute buildings will rise on land near Bexley Hall, according to present plans.

DEVELOPMENT PROGRAM

Allocation of Funds Subscribed
January 1, 1948 — June 30, 1951

Buildings and Facilities		$ 9,000,637
Sloan Building and Faculty Club	$2,600,000	
Dorrance Laboratory of Biology and Food Technology	2,500,000	
Kresge Auditorium and Chapel	1,250,000	
Hayden Library	1,189,824	
Sloan Metals Processing Laboratory	1,021,317	
12-M.E.V. Generator Building	188,038	
Dormitories	185,212	
Hydrodynamics Laboratory	66,246	
Permanent Capital Funds		4,464,547
Endowment Funds		
General Purposes	1,873,604	
Designated Purposes	2,070,943	
Annuity Fund	20,000	
Principal of Funds supplying income to Institute	500,000	
Unrestricted Funds		1,874,609
Unallocated Unrestricted Funds	774,213	
Unallocated Unrestricted Subscriptions	1,100,396	
Funds for Current Operations		5,811,777
Operating Funds — Research Funds, Fellowships, and Development Program Expenses	2,610,596	
Operations of School of Industrial Management (Alfred P. Sloan Foundation Grant)	2,750,000	
Scholarship and Prize Funds	451,181	
Industrial Liaison Program		4,516,962
TOTAL		$25,668,532

Achievements of the Campaign

The foregoing table shows that while the intensive drive of the Development Program more than achieved its financial goal of $20,000,000, some of our major objectives, as announced at the beginning of the campaign, remain unfulfilled. There are several reasons for this. In the first place, we included contributions and support for current operations in the total, as mentioned above. Moreover, some gifts were given for specific projects not originally included in Development Program plans. Most notably this is true of the $5,250,000 grant of the Alfred P. Sloan Foundation, Inc., for the establishment of a School of Industrial Management. Finally, rising material and labor costs within the past several years have forced up the costs of the new buildings despite every effort on our part to modify plans in the light of higher prices. The Biology and Food Technology Laboratory, planned originally as a $2,000,000 building, will finally cost more than $3,000,000. It was expected that the library and humanities center would cost $3,200,000; its final cost was close to $4,000,000.

Two buildings originally projected have, therefore, still to be provided. To bring together our widely scattered and inadequate facilities in electronics and nuclear science, a laboratory for the physical sciences is a first priority building need in the days ahead. Another one of the Development Program objectives which has not been obtained is a gymnasium. This, too, is still urgently needed.

More serious than the inability to finance the complete building program specified in the objectives of the intensive drive, is our failure to obtain the desired increase in capital funds. In the long-range financial operations of the Institute, such funds are by far the most important.

This having been said, it remains a fact that the Development Fund campaign has been a magnificent success. It has given us a new measure of our strength. It has given us a measure of the size of the responsibility which we must assume if this great technological institution is to continue to serve the nation and the world to the extent of its full potential.

During the Development Fund campaign, we held the great Mid-Century Convocation on the "Social Implications of Scientific Progress," which brought Winston Churchill and a galaxy of other distinguished visitors to our campus. This occasion furnished an impressive reminder of the Institute's role in an age in which science and its applications are so powerfully felt, and in a world in which extensive undeveloped regions need the help of science and technology if they are to afford their populations a tolerable and dignified existence.

When the Charles Hayden Memorial Library was dedicated in May, 1950, a new era in the advancement of nontechnical studies was ushered in at the Institute and engendered immediate favor with "the Engineers." The Exhibition Gallery (above) *now provides opportunity to display on Technology property important works of art. The gallery is in constant use throughout the year, and draws visitors from the populace of Metropolitan Boston, as well as from the Institute's student body of approximately 5,000. The Music Lounge* (right) *provides programs of classical recordings through the school day, and is a popular congregating place for music-loving students. In addition to the lounge, a number of smaller listening rooms are available with record players for individual study of musical scores.*

CONTRIBUTIONS TO M.I.T. DEVELOPMENT PROGRAM BY CLASSES

Totals as of June 29, 1951

Class Year	No. of Subscriptions	Total Amount	Class Year	No. of Subscriptions	Total Amount
1882	1	$ 5.00	1919	122	$ 66,881.50
1884	3	135.00	1920	181	87,275.54
1885	2	30.00	1921	241	98,554.00
1886	3	3,105.00	1922	352	164,239.50
1887	3	1,011.00	1923	309	243,295.00
1888	8	31,753.50	1924	244	89,339.99
1889	5	3,350.00	1925	217	64,997.00*
1890	16	18,750.00	1926	268	87,967.80*
1891	14	2,263.00	1927	256	84,900.00
1892	10	3,012.00	1928	259	76,719.00
1893	24	6,555.00	1929	222	45,835.50
1894	15	13,145.00	1930	210	42,961.00
1895	16	53,047.00	1931	228	37,062.00
1896	39	42,809.00	1932	254	33,588.00
1897	22	404,543.57	1933	256	149,204.41
1898	30	8,090.00	1934	282	50,531.00
1899	33	61,790.00	1935	242	39,968.00
1900	39	21,235.00	1936	232	28,575.00
1901	59	673,276.25	1937	217	27,106.50
1902	45	141,503.13	1938	221	23,303.00
1903	59	32,926.00	1939	285	45,526.00
1904	51	20,720.00	1940	296	31,640.00
1905	68	78,935.00	1941	257	26,737.50
1906	87	58,185.00	1942	267	24,088.50
1907	72	110,778.75	1943	268	19,554.90
1908	81	34,278.00	1944	255	23,476.63
1909	80	74,393.00	1945	136	8,495.00
1910	95	30,503.00	1946	178	9,973.50
1911	113	62,671.50	1947	277	15,841.66
1912	111	71,534.00	1948	376	21,246.50*
1913	139	86,493.75	1949	226	12,704.25
1914	113	49,865.00	1950	81	1,695.50
1915	155	139,744.00	1951	2	130.00
1916	149	84,483.00	*TOTALS*	9,820	$4,391,101.88
1917	187	135,450.00			
1918	156	47,319.75*			

* Gifts from corporations counted in class totals by request.

The Convocation was held on March 31, and April 1, 1949. In June, 1950, the Communists moved against the Republic of Korea. This invasion alerted the free world to the danger of a major aggressive move by the Soviet Government. It made necessary a tremendously increased program of national defense. In the ensuing months M.I.T. has been called upon to undertake a large program of defense work. It can be a source of deep satisfaction to all who have contributed to the fund-raising drive, to know that because of the financial support thus obtained, M.I.T. has been ready for the emergency demands as it would not have been if the campaign for funds had not been such a success.

The names of all who have contributed $300 and over to the Development Program will appear on a bronze plaque in an appropriate place of honor at the Institute, as soon as the materials shortage makes it possible to obtain the bronze. A Book of Remembrance containing the full record of all contributors was presented to the Alumni Association by the chairman of the C.F.D. on Alumni Day, 1951, and will be preserved among the archives of the Institute.

In any list of names, those of Marshall B. Dalton, '15, and Alfred P. Sloan, Jr., '95, will shine with a special light. Mr. Dalton brilliantly directed and led the campaign, giving a substantial portion of his time to it. Few institutions have ever commanded such devotion and effective service as he has given M.I.T. Mr. Sloan's munificence, enthusiasm and vision of the opportunity which M.I.T. must grasp, served to increase the value of all other contributions by increasing so significantly the size of our total achievement. To Mr. Sloan, to Mr. Dalton, to all who worked as members of the Committee on Financing Development, to all who made gifts and contributions, and to the staff and employees of the Institute whose contribution has been too all-pervasive to be recorded, M.I.T. and the nation it serves, can give grateful thanks.

Of Yankee Granite — II

Between 1825 and 1842, When the Bunker Hill Monument Was under Construction, Great Strides Were Made in the American Construction Industry

By E. H. CAMERON

IN the May, 1952, issue of The Review, Part I of this article described the promotion and design of the monument, and the quarrying of the stone. Part II, which follows, describes the Granite Railway and the erection problems of the monument.

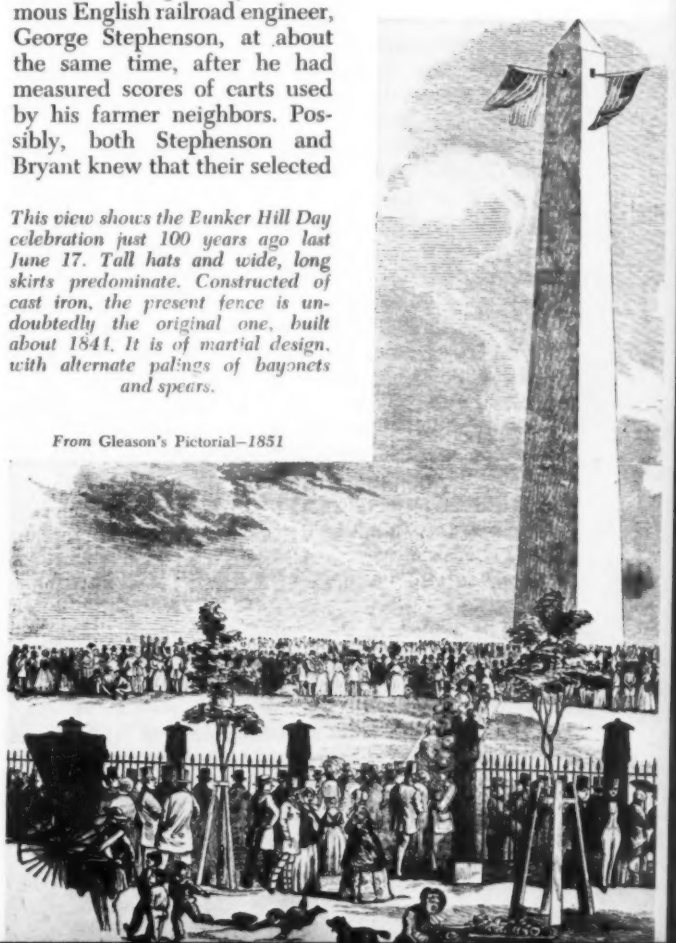
The Granite Railway

On October 7, 1826, the first railroad in America started operation. This was the horse-operated Granite Railway, built to transport the stones for the Bunker Hill Monument from the quarry in Quincy down to the Neponset River, a distance of nearly three miles. The track and cars of the railroad had been designed and built by a young engineer of 28, Gridley Bryant, whose Granite Railway project started him on a long career of achievement in the invention of equipment that played a major part in the rapid and successful development of the American railroad system.

Ample precedent for the Granite Railway existed in England, where, since the reign of Charles II, wooden tracks, sometimes armored with iron plates, had been used as runways for coal cars from the pits to the nearest waterway. Within five years of the start of the Granite Railway, similar systems are recorded in the states of Pennsylvania, South Carolina, New York, and Maryland. At first, the motive power for these lines was supplied by gravity, stationary engines, or horses, but soon tiny steam locomotives were tried. Thus, in the year 1829, Peter Cooper built the famous *Tom Thumb*, a successful locomotive which used rifle barrels for flues. In the same year the *Stourbridge Lion*, "the first locomotive that ever turned a driving wheel on a railroad on the Western Continent,"[6] was brought by sailing vessel from England and started operation in Pennsylvania. The American steam railroad system was thus well under way by the time the lower courses of the monument were being raised.

Bryant later described his railroad as having stone sleepers laid across the track, 8 feet apart. Upon these, were placed wooden rails, 6 inches thick and 12 inches high (replaced by stone within a few years). Spiked on top of these were iron plates, 3 inches wide by ¼ inch thick. However, at road crossings, stone rails were used, with 4-inch by ½-inch iron plates bolted on top. This "permanent" construction was also used on the double-track, inclined plane at the quarry. (Well-preserved vestiges of this "permanent" construction are visible today at the rise to the Bunker Hill quarry.) Here, an endless chain allowed the loaded, descending cars to pull up the empty ascending ones.

The standard gauge of American railroads is now 4 feet, 8½ inches, measured between railheads, a standard adopted after many years of confusion before the present gauge dimension was adopted. Although Bryant described his track gauge as 5 feet, this dimension was measured between the "bearing points" of the wheels on the tracks. If the bearing points are assumed to be the center of the treads of the wheels, his gauge is found to match closely the present standard gauge. This track gauge agrees with that adopted by the famous English railroad engineer, George Stephenson, at about the same time, after he had measured scores of carts used by his farmer neighbors. Possibly, both Stephenson and Bryant knew that their selected



This view shows the Bunker Hill Day celebration just 100 years ago last June 17. Tall hats and wide, long skirts predominate. Constructed of cast iron, the present fence is undoubtedly the original one, built about 1841. It is of martial design, with alternate palings of bayonets and spears.

From Gleason's Pictorial—*1851*

[6] *Annual Report of the Smithsonian Institution*, 1889.

guage had a very early beginning; for some historians suggest that the English carts were originally made to fit the ruts cut in the roads of Britain by the Roman chariots, many centuries earlier, during the Roman occupation of Britain.

On the day when the railroad started operation, 16 tons of granite from the Bunker Hill Quarry, and loaded on three "wagons," were easily pulled by one horse, once started. Bryant's first car had flanged wheels, 6½ feet in diameter, from the axles of which a platform was hung to carry the granite. This platform was lowered to receive the load and then raised by an ingenious gearing device.

Naturally, Bryant based the design of his early railroad cars upon the construction of the horse-drawn wagons of his day. Like the wagons, his cars had to be flexible if they were to keep on the track when passing over the two curves of the otherwise straight Granite Railway. In his description of another of his cars appear the road wagon terms – bolsters, truck, and center kingpin, to allow a swiveling motion. Rigidly bolted to cross timbers beneath the truck were two iron axletrees, on which revolved cast-iron wheels. (Some time would elapse in railroad progress before the wheels would be fixed to, and revolve with, the axles in journals.)

In early American railroad development Bryant is credited with the invention of the eight-wheel car, the turntable, switch, turnout, and many other improvements. In 1823, he had invented and used in the building of the United States Bank at Boston, his portable derrick, "used in every city and village in the country wherever there was a stone building to erect." Others profited from Bryant's amazing ingenuity. Although the Supreme Court of the United States decided in his favor in his most important invention, the eight-wheel car, he did not collect, and he died poor.[7]

In the fine saga of the Bunker Hill Monument, the Granite Railway plays a prominent part. The demand of the monument for granite definitely inspired Bryant to conceive the idea of America's first railroad, and to design pioneer equipment that contributed hugely to the subsequent progress of America's great railroad system. The accurate account of the building of the monument, however, has to record the fact that the railroad was not so great a benefit as anticipated. In the short distance of 12 miles there was too much loading and unloading. Willard freely expressed his annoyance at these hindrances. That he took action is indicated in the following quotation from an apparently authentic source: "The stone used for the foundation and for the first forty feet of the structure (the monument) was transported from the quarry on a railroad to the wharf in Quincy (actually located in Milton) where it was put into flat-bottomed boats, towed by steam-power to the wharf in Charlestown, and then raised to the Hill by teams moving upon an inclined plane. The repeated transfer of the stones, necessary in this mode of conveyance, being attended with delay, liability to accident, and a defacing of the blocks, was abandoned after the fortieth foot was laid, and the materials were transported by teams directly from the quarry to the hill."[8] This account fails to tell how the teams got up and down the steep hill at the quarry: the 84-foot rise at an angle of 15 degrees. Clever Bryant must have used his endless chain to drag the empty teams up, and to brake the loaded ones down.

[7]For more data on the Granite Railway and Gridley Bryant, *see:* Charles B. Stuart, *Civil and Military Engineers of America* (New York: D. Van Nostrand Company, Inc., 1871); and *The First Railroad in America* (Boston: Privately printed for Granite Railway Company), 1926.

Beacon for Mariners

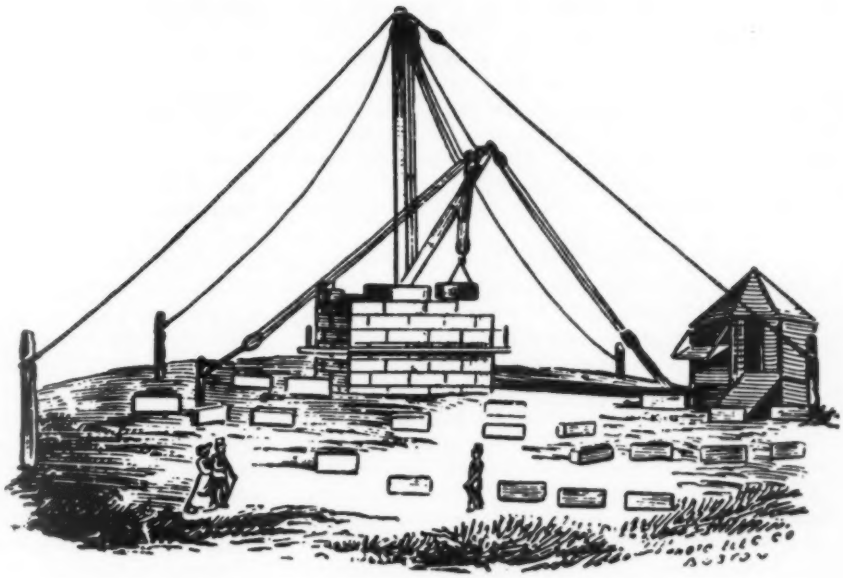
In the noisy grogshops on the streets leading to the Boston waterfront, in the sail lofts on what is now Commercial Street, and at the tall desks of the counting rooms of State Street, those who got their living from the sea eagerly discussed the progress of the monument in Charlestown. It was to be their beacon, and when the many frigates, packets, sloops, and schooners had safely passed the danger spots of the lower harbor, the monument would welcome them to the busy inner port of Boston, then much livelier than it is today. But progress proved to be slow. Naturally the stones broken from the Quincy ledges and boulders were not always of the dimensions planned by Willard for the lower courses; many were of sizes needed for the upper courses. Economical Willard dressed the stones as they came out; setting aside those which could not be erected for some time; and the piles of such stones grew larger at Quincy and on the ground about the monument, while the monument itself rose at a snail's pace. A more spectacular progress was needed for a project that was started on a shoestring, and depended on more and still more public contributions. The building fund dwindled to such a low sum that in February, 1829, work had to be suspended for lack of funds to pay the wages of quarrymen, stonecutters, derrickmen, blacksmiths, and teamsters, and the cost of the good hay for the hard-working horses and oxen of the project. But 14 courses had been laid – to a height of 37 feet, 4 inches. The sailors were disappointed, and a poetess said:

> But where's the pile they said would rise,
> Throwing its shadows o'er the wave, –
> Lifting its forehead to the skies –
> A Beacon far o'er land and sea,
> Signal and Seal of Liberty.

A lottery to secure more building funds was next proposed. It was not unusual to allow lotteries in this period – churches, turnpikes, bridges, and even Harvard College – had received such grants. Public sentiment in Massachusetts, however, was beginning to consider lotteries a vicious practice and the directors of the Bunker Hill Monument Association voted against one.

At this time, Amos Lawrence was a member of the building committee – a wealthy philanthropist of Boston, whose religion seemed to be fixed on two ideals, one of which was his charities. Unlike that of a few good ministers of the time, who had preached against giving funds for the monument

[8]George E. Ellis, *History of the Battle of Bunker's (Breed's) Hill* (Boston: Lockwood, Brooks and Company, 1875).



This crude sketch published in 1830, shows a stone ready to set, but, strangely enough, no workmen are shown, on the staging, to guide it to its final, precise position. Tackles are shown, attached to the end of the boom, to revolve the mast to bring the stone to its desired placing position.

From Bunker Hill Memorial Tablets—1889

because they felt their various charities should come first, Lawrence deemed the completion of the Bunker Hill Monument of first importance. This project became his other obsession. He enlisted the aid of the Massachusetts Charitable Mechanics Association in the campaign for funds. Started in 1795 by Paul Revere, and others, to promote a better understanding between master mechanics and their apprentices, this society had become influential; its membership embraced mechanics, manufacturers, and such honorary members as Ex-President Adams, Daniel Webster, and Edward Everett. Amos Lawrence had picked upon a well-managed organization for assistance; its executives were shrewd financiers and they knew how to get things done. The president of the Massachusetts Charitable Mechanics Association became in perpetuity the first vice-president of the Bunker Hill Monument Association (today he is still so listed). Thereafter, the Mechanics Association took an active part in the promotion and construction of the monument. It made a careful estimate of the cost to complete the monument and, much to Solomon Willard's disgust, raised his allowance for contingencies. Both associations decided to be satisfied when the monument had reached the height of 159 feet, 6 inches – about two-thirds of the height previously determined upon.

Work was resumed on June 17, 1834, and continued until funds again gave out, when the monument was 32 courses high, 85 feet; now imposing enough for the good mariners of busy Boston harbor to take notice of. It was the year 1835, and the country was headed for a severe financial depression – a bad sign for those who sought contributions for any but the most practical of objectives. In this emergency, the women of New England again became active in the raising of funds.

In the summer of 1840, a common greeting of the women of Massachussets was: "What are you doing for the Fair?" Those who knit stockings, crocheted in worsted of various colors, who were skilled in embroidered work, or who were merely good at plain sewing strove industriously to get ready for the Fair that was to earn money for the Bunker Hill Monument. Ten years earlier, the women of New England had made a noble effort to secure funds for the monument, but as the contributions from females and children had been limited to a maximum of $1.00 each, the total was small. Now, although the maximum sum ever raised at a Boston fair was $3,000, they felt that a sizable sum could be realized in a fair in Quincy Hall, near Faneuil Hall. Despite the criticism that "women were stepping out of their sphere," Sarah J. Hale, the leading spirit in this remarkable effort, persisted.[9] Quincy Hall was 382 feet long by 47 feet wide, and it was crowded with the 43 tables of things to sell, when the seven-day fair started in September, 1840. A Whig Convention, in this year of a presidential election, undoubtedly helped to increase the attendance at this very successful fair. The price of admission on the first day was double that of the remaining days, which was $0.25.

The success of the Quincy Fair was phenomenal. The net sum of $30,035.53 was realized and turned over to the directors of the Bunker Hill Monument Association toward the completion of the Bunker Hill Monument. This amount was nearly one quarter its total cost. The Yankee ladies did not know that two contributions of $10,000 each, with several smaller donations were available by now. The gift of $10,000 by Judah Touro was peculiarly heartening, as an example of the expression of the gratitude of the son of an immigrant to the country of his adoption. The father of Touro had been rabbi of a synagogue in Holland. The younger Touro was born in Newport, R.I., in 1776; he had sailed to New Orleans with an assortment of New England commodities and had made money in their sale. A soldier

[9]She was editor of *Godey's Lady's Book* for 30 years, and is credited with promoting the establishment of the last Thursday in November as Thanksgiving Day.

in the Battle of New Orleans, in the War of 1812, he had been given up for dead in that battle. He had become a millionaire and, learning of the proposed gift of $10,000 by Amos Lawrence, toward the completion of the monument, Touro had matched it. Thus, in the year 1840, the success of the Bunker Hill Monument was assured. It could now be built to the full height planned by Baldwin and Willard – about 220 feet.

The Riggers

Contractor James Sullivan Savage would have no trouble finding good men for the ticklish job of raising and setting the heavy stones of the higher courses of the monument; able sailors, who would take a shore job for a change. Maritime Boston was full of these good riggers, who were used to dizzy heights, and to whom the half hitches, square knots, guys, slings, and tag lines would be easy. Up to this time the monument had been built by day labor, not by contract. Now, Savage had taken a contract to finish the monument for $43,800, from the elevation of 85 feet to the top. He was well trained in masonry, for he had worked on the job since the start under Willard, whose rigid ideas would not let him take a contract himself for profit on such a patriotic project, but who agreed to superintend the work of Savage to the finish. Savage had the traits of a good contractor – energy, resourcefulness, honesty – and the sense that knew how each detail must be executed toward the end of producing a job to be proud of.

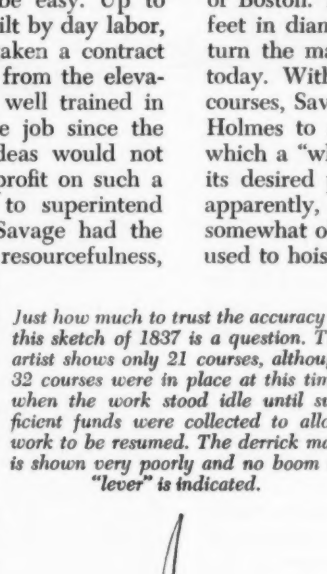
Savage replaced the one-horse capstan of the hoist by a six-horsepower steam engine, an innovation that speeded up progress. The steam engine as a prime mover in land and water transportation had become well established, and its use to drive textile machinery had proved successful. Steam power in the construction industry, however, was a novelty. Shouts and wigwag signals from the setting gang at the top to the engineer on the ground were replaced by a bell-wire signaling system. This must have been a pull bell, for many years would pass before electric bells came into common use.[10]

As its lighter stones would be easier to handle, the granite inner cone (newel) around which the stairs wind, was erected a few courses ahead of the walls of the monument. It thus served as a support for the derrick which raised the heavier wall stones. Through apertures in the hollow walls of the newel, a heavy beam (wood?) was passed, upon which the derrick was set.

It is interesting to compare our modern hoisting derrick with the apparatus used to raise the stones for the monument. The derrick of today consists of a guyed, vertical mast, an adjustable boom hinged to the base of the mast, with boom falls, and hoist falls, each with their cables and pulleys, or blocks. At the base of the mast, a bull ring serves to turn the mast by power. The whole combination is called the derrick. When we get accustomed to the old English or American custom of calling the mast the post or derrick, and the boom either the gaff or derrick, a little study enables us to comprehend how the monument was built.

The lower courses were raised by the "Holmes Hoisting Apparatus," designed by a practical seaman of Boston. This device could command a circle 100 feet in diameter. Except that it had no bull ring to turn the mast, it appears much like the derrick of today. With steam power available for the upper courses, Savage seems to have modified the boom of Holmes to serve as a nearly horizontal "lever," on which a "wheel carriage" drew the stone inward, to its desired position for placement. In other words, apparently, the boom became today's monorail. A somewhat obscure, English description of the means used to hoist masonry 100 years ago, tells of two devices. One was a "movable derrick crane," with a vertical post, supported by two timber backstays, and a movable hinged "jib or derrick," which could be today's boom. This assembly, of course, corresponded to today's stiff-leg derrick, in which the back guys are replaced by timber members. The other English device for raising stones was practically exactly like today's traveling crane, and that was the name it went by in England, 100 years ago.

Just how much to trust the accuracy of this sketch of 1837 is a question. The artist shows only 21 courses, although 32 courses were in place at this time, when the work stood idle until sufficient funds were collected to allow work to be resumed. The derrick mast is shown very poorly and no boom or "lever" is indicated.



From Bunker Hill Memorial Tablets–1889

Our construction forebears of over a century ago had to use ropes and chains for all purposes; there were no wire ropes. About the time Savage set his first stone, John A. Roebling was making the first American wire rope cable, in a largely outdoor plant located on a level meadow on his farm in Saxonburg, Pa. Wire rope had real advantages in construction work, because of its superior strength and its much less stretch under load. A crude sketch, dated 1837, shows that the derrick for the monument was guyed by chains, which attached to the top of the mast and passed over timber brackets at the staging level, and thence vertically down to weights at the ground. In this long length, the stretching and shrinking of a rope under rain, load, and temperature changes would be difficult to control.

(*Continued on page 438*)

[10] Joseph Henry had developed the electromagnet at about the time of the laying of the lower courses of the monument, and, a few months after its dedication, Morse would operate the first telegraph line between Washington and Baltimore, but the transmission of electric currents by insulated wires even for a few score feet was still too new to receive serious attention on a construction job.

AMERICAN EFFORTS TO SECURE Uniform International Coinage, 1863-1869

The Civil War Stimulated the United States to Play an Important Role Aimed at Achieving Uniform International Currency

By D. G. BRINTON THOMPSON

THE idea of a uniform coinage among the principal commercial nations is not new and has been much discussed, but the unanimous recommendations of the International Monetary Conference of 1867 came perhaps the closest to achieving this ideal. The United States was not only a member of this congress but through its representative, Samuel B. Ruggles, played an important role.

The attempt to unify weights and measures by means of the metric system naturally turned men's minds to the great diversity of coinage. While unification of coinage had been discussed at earlier statistical congresses the matter came to a head at the Fifth International Statistical Congress* held at Berlin in 1863, where a resolution passed in favor of assimilating the coins of different countries.[1, 2] This resolution was presented by the United States delegate Samuel B. Ruggles. This occasion marks the first time that the United States had an official representative at the International Statistical Congress although unofficial observers attended previous meetings. The American delegate, Ruggles, was a distinguished New Yorker, 63 years of age and of commanding presence. He had been a prominent Whig, a great figure in the enlargement of the Erie Canal, and a noteworthy benefactor of New York City, not only by his permanent improvement of the street system but also as trustee of Columbia College and the Astor Library. He was a personal friend of William H. Seward, Secretary of State, as well as of Hamilton Fish, Seward's successor.[3]

In August, 1863, Ruggles received a summons to Washington from Seward, who insisted, despite his reluctance, that Ruggles represent the United States at the Statistical Congress that was to meet at Berlin on September 6.[4] Appointed on the 14th he "was orally but specially directed by President Lincoln, and by Mr. Seward, the Secretary of State, to present to the International Statistical Congress at Berlin such statistical and other evidence of the resources of the United States as would exhibit to Europe the ability of the National Government fully to maintain its legitimate authority in the struggle then pending, and to save the American Union from dismemberment and ruin."[5] Ruggles' wide experience in both public and private life and his interest in statistics made him a good choice for the position. Seward had broad motives in taking this action; as Henry Adams said of the Secretary's activities in 1863, "Mr. Seward set vigorously to work and sent over every important American on whom he could lay his hands."[6]

Much of the business at the congress had to do with a uniform international system of weights, measures, and coins. The discussion, particularly in relation to coinage, laid the groundwork for later important international debate. On this question the delegates agreed on two resolutions, which declared first, that the number of existing units of money should be reduced, should be decimally subdivided, and should be of the same degree of fineness; and second, that an international congress should be called to deal with these problems. Hope was expressed by some that the United States and Great Britain would agree to a common gold standard, and that something would be done to standardize silver coinage on a wider basis.[2] Ruggles "advocated universal unification on the basis of the French gold piece of five francs" and declared the effort to establish a fixed ratio between gold and silver would prove a "vain attempt."[7] The idea of monetary unification on the basis of the five-franc gold piece or multiples thereof, which was agreed to at the Monetary Conference of 1867 and will be explained later, may have occurred to many but it seems certain that Ruggles was the first to bring it before an international body. He probably obtained most of his ideas from Henry R. Linderman, Director of the Mint of the United States, who had previously outlined the scheme in a letter to the Treasury Department.[8] Ruggles acquired a real enthusiasm for a unified currency among the principal nations of the world, and inspired the Chamber of Commerce of the state of New York to take considerable interest in the matter.

With the spirit of a true showman, Napoleon III decided to hold an International Exposition at Paris in 1867 which should be a wonder to the world for years to come. Thirty commissioners, representing the United States in various capacities, arrived in Paris in March, 1867. Ruggles, Frederick A. P. Barnard, President of Columbia College, John P. Kennedy, and one Smith were appointed to consider a uniform system of weights, measures, and coins; Ruggles and Kennedy were assigned to the subcommittee dealing exclusively with coins.[9] Ruggles advocated the adoption of a 25-franc gold piece, and Kennedy concurred. Ruggles believed this action proved one of

* Please see numbered references at end of article, page 434.

the influences which determined the French Government to issue a hurried call for an International Monetary Conference.[9] This conference reached such important decisions that a brief review of monetary history, particularly in the United States, is advisable.

The Mint Act of 1792 in the United States provided for the free coinage of both gold and silver at a ratio of one to 15. Since the ratio between silver and gold was 15½ to one in the open market, the gold coins were undervalued. Because of Gresham's law or for other reasons the gold coins disappeared from circulation. Almost all of the silver coined was in denominations of less than $1.00. In 1834, Congress, believing the scarcity of gold coin undesirable, changed the ratio between the metals to 16 to one by reducing the weight of the gold dollar. In the period from 1834 to 1860, inclusive, roughly $450,000,000 in gold was minted, most of it after the gold rush of 1849. This large amount of gold coinage circulated freely and formed a sizable proportion of the circulating medium. In the same period, total silver coinage amounted to less than $150,000,000, only $2,700,000 of which consisted of silver dollars. During the Civil War both gold and silver coins disappeared and paper bills or "shinplasters" came into use even in the place of five-cent coins.[10, 11]

Great Britain had been on the gold standard since 1816, but she felt concerned over the fate of silver in other countries especially because of the large amount of silver held in India. France had been on a bimetallic standard since the Revolution at a ratio of 15½ to one. In 1865 France, Italy, Belgium, and Switzerland had formed a monetary alliance known as the Latin Union with the franc as the unit of exchange. Most of the other states of Europe were on a silver standard.

To return to the *Exposition Universelle de 1867*, Seward received from Berthemy, representing the French Government, a formal invitation, dated May 27, to an international monetary conference to meet in Paris on the 17th of the following month to take up the "general question of uniformity of coinage." Ever since January there had been a desultory correspondence between Berthemy and Seward, the former inquiring in general terms the latter's opinion upon American participation in some agreement on the subject of coinage with the powers that had concluded the monetary convention of 1865. Seward had replied in equally vague terms, expressing his interest.[12]

Ruggles was busy on the Exposition's subcommittee on coins, which did not finish its labors until June 17, the very day the International Conference was to begin. In May he had an interesting exchange of letters with John Sherman, chairman of the Finance Committee of the Senate. He wrote to Sherman, then in Paris at the Hotel Jardin des Tuileries, telling him briefly of the work being done by the subcommittee. He added: "May I ask what, in your opinion, is the probability that the Congress of the United States of America would agree at an early period to reduce the weight and value of our American dollar, to correspond with the present weight and value of the gold five-franc piece in France, and how far such a change would commend itself to your own judgment."[13] Sherman replied next day that although the matter had hardly been discussed in Congress, "I feel quite sure that Congress will adopt any practical measure that will secure to the commercial world a uniform standard of value and exchange . . . As coin is not now in general circulation with us, we can readily fix by law the size, weight and measure of future issues . . ."[14] The promptness of the reply suggests that Sherman had previously discussed this matter with Seward or Ruggles or both. Seward also looked with favor on this plan of unification.

Opening of Conference

The International Monetary Conference opened on the date set, June 17, with "all the independent sovereignties of Europe, with the possible exception of some small portions of northern Germany" in attendance, but the United States was the only non-European country represented. Each nation had one vote. The congress agreed to five propositions, namely:

1. A single standard exclusively of gold.
2. Coins of equal weight and diameter.
3. Coins of equal quality, nine-tenths fine.
4. The weight of the five-franc gold piece, 1612.9 milligrams with its multiples, to be the unit. Issuance of a 25-franc gold piece unanimously recommended to serve with half eagle and sovereign as international coins.
5. Coins of each nation to bear the names and emblems preferred by each, but to be legal tenders, public and private, in all.[15]

The official record of the conference shows that Ruggles, the American representative, played an active part in the proceedings. In the early part of the session he pointed out the importance of achieving monetary union without delay, since (because of the Civil War) the United States then had no circulating coinage to speak of, and since the increased volume of coinage in other countries would, if action were delayed, make international standardization burdensome. Although bimetallism existed legally, he said that since 1834 we had been practically on the gold standard and had minted only a small number of silver dollars.[16]

At the third sitting, June 20, the important question of the gold standard came to the vote. The conference voted unanimously in favor "of adopting the exclusive gold standard, leaving each state the liberty to keep its silver standard temporarily."[17] The delegate from the Netherlands cast his vote with a minor reservation. Ruggles insisted on the advisability of coining a 25-franc gold piece to correspond to the sovereign and the half eagle, and submitted a written argument to that effect. When the question arose concerning the date of the next meeting (at which time the delegates were to report the action their governments were prepared to take on the proposed unification of coinage), he argued that it would be well not to meet before May 15, 1868, so as to allow our congress a chance to deliberate. He was overruled, however, and February 15 was chosen. The conference adjourned on July 6, 1867.

This international conference is distinguished in that it reached a unanimous agreement on a course of action. Much credit is due to the committee on

agenda; its seven members included Ruggles, with Thomas Graham of Great Britain as chairman. The American delegate had been prominent in the deliberation, and, moreover had kept in close touch with Washington. The international monetary conferences of 1878, 1881, and 1892 broke up in complete disagreement, which indicates poor preparation; for an international conference should not be called unless there is some likelihood of a certain amount of agreement. Unfortunately, international conferences are sometimes called for reasons that are not too much concerned with international accord. Berthemy, French Imperial Foreign Minister, wrote to Seward after the conference, praising our representative highly. Both Seward and Hugh McCulloch, Secretary of the Treasury, replied praising the conference on the result of its labors.[13, 14, 15]

Seward had requested Ruggles to make "observations" of the conference and he was not the man to allow such an opportunity to escape. From Paris, on November 7, he dispatched a long letter to Seward which when printed covered 16 pages.[15] He showed that 72,000,000 people used the franc; that, whereas the United States would certainly not have more than $300,000,000 in gold to recoin, and Great Britain $500,000,000, the states that used the franc would have $1,800,000,000 to remint. Furthermore he wrote:

> We cannot wisely or rightfully remain in continental isolation. Integral portion of the mighty organism of modern civilization, let us fraternally and promptly take our part in the world-wide works of peace . . .
>
> The establishment of the single standard exclusively of gold, is in truth the cardinal, if not the all-important feature of the plan proposed by the conference, relieving the whole subject, by a single stroke of the pen, from the perplexity and indeed the impossibility of permanently unifying the multiplicity of silver coins scattered through the various nations of Europe. It is a matter of world-wide congratulation, that on this vital point the delegates from the nineteen nations represented in the conference were unanimous—not excepting France itself, so strongly wedded by its national traditions to a double standard.[15]

He reasoned that the necessity of changing slightly the gold content of the dollar should cause no anxiety, since "no practical inconvenience was experienced by the Act of Congress of 1834, which reduced the weight of the gold dollar more than five per cent."

Returning to America in November, Ruggles went to Washington, where he presented a report personally to President Johnson, who "did not seem quite to understand the matter."[19] He also gave both the President and Seward a specially minted 25-franc gold piece as a gift from the French Government. Johnson and Seward wrote letters of thanks to the French authorities commending their efforts "to produce a common coin for the use of the nations."[20]

Despite the rare exhibition of international unanimity at the monetary conference, little came of it. Ruggles endeavored to press the matter through Congress. Frederick T. Frelinghuysen, Senator of New Jersey, introduced a bill March 3, 1868, to accomplish the purpose, and it was referred to the Committee on Finance. In that committee it became combined with another bill on the subject of coinage, and in an amended form reported favorably by the majority. An adverse minority report was also presented. The bill contained 10 sections. The first three were important, establishing the weight of the $5.00 gold piece equal to 25 francs, fixing the weight of subsidiary silver, discontinuing the silver dollar, and making the new gold coins legal tender for all payments "except for such existing bonds of the United States as are payable in coin." This last provision aimed to maintain the integrity of the United States in its promise to pay in terms of the old dollars and would have entailed the expenditure of only a few more pennies per dollar.[13, 21]

John Sherman of Ohio, chairman of the committee, made the favorable, and Edwin D. Morgan of New York, the adverse, report. The reports of the two senators, with Ruggles' report appended, were published by the Senate. Sherman repeated the various arguments already noted in favor of an international coinage and showed the trifling effect of the change in weight of the dollar. Morgan, in his minority report, said that the change in the dollar "should be made only after the most mature deliberation," and he pointed to the disturbed times as a poor period in which to make this weighty decision. Furthermore, he saw no valid reason why the dollar as it stood should not be the international standard, and he added a letter from a Mr. Dunning objecting to the franc since its weight could only be expressed by an awkward fraction in the metric system.[22, 23] These last two objections were continually raised against the suggested standardization. Both the flag-waving patriot and the stickler for metric round numbers could see no virtue in the use of the franc as a standard. On June 9, Sherman, for the committee, asked "that the subject be postponed until the next session of Congress without further action," which was agreed.[24] That action seems to have marked the end of that particular bill.

In continental Europe many nations had joined the Latin Union, others were seriously considering doing so, and all the important remaining countries seemed favorably disposed to the 25-franc gold piece as a standard. In Great Britain the Royal Commission appointed to investigate the matter reported in 1868. The commission while agreeing with much that was done at the monetary conference stated "we do not recommend that this country should merely adopt a gold coin of the value of 25fr, to be substituted for the sovereign."[25] They were frank in describing many of the advantages that would accrue if the principal nations of the world assimilated their coins but doubted whether Great Britain would benefit sufficiently to warrant changing the value of the sovereign with its attendant difficulties. The tone of the report was mild and certainly did not shut the door against further negotiations. The Canadian Parliament was considering a bill to follow the lead of the United States in the matter.

In December, 1869, Sherman made another attempt "to promote international coinage" by introducing an appropriate bill. Evidently he ran into some difficulty in committee for on February 8, 1870, he offered a resolution requesting the President "to write a correspondence with Great Britain and other foreign

(*Continued on page* 432)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Robnett Aids Brooks in Administration of New School

ANNOUNCEMENT comes from E. P. Brooks, '17, Dean of the School of Industrial Management at the Institute, of the appointment of Professor Ronald H. Robnett as associate dean of the new School at M.I.T. In his new post Professor Robnett will share with Dean Brooks in the administration of the School of Industrial Management which will open next autumn. The School was established with a grant of $5,250,000 from the Alfred P. Sloan Foundation last year, and an additional $1,000,000 was recently granted for a program of research on problems of industrial management.

Professor Robnett, who holds the rank of professor of accounting in industrial management, has also served recently as fiscal officer of the Division of Industrial Coöperation at the Institute.

A native of Salem, Ore., where he was born in 1905, Professor Robnett was educated at the University of Oregon, from which he was graduated with the degree of bachelor of science in 1928. He remained at the University of Oregon for four years after his graduation, serving as assistant graduate manager. He then did graduate work at Harvard University, receiving the degree of master of business administration in 1934, the year in which he joined the staff of the Institute as an assistant in the Department of Business and Engineering Administration. He was promoted to the rank of assistant professor in 1937, associate professor in 1942, and has held his present rank since 1947. During 1942 he served as visiting lecturer in accounting at Harvard University.

M.I.T. Photo

Professor Ronald H. Robnett

Associate Dean, School of Industrial Management

Professor Robnett was a member of the Institute's Committee on Educational Survey from 1947 to 1950 and was a member in 1947 of the Advisory Board on Relationships of the Atomic Energy Commission with its contractors. In 1948 he served on the Advisory Committee Research and Development Contracts of the Department of the Army, and in the following year was consultant to the chairman of the Research and Development Board of the Department of Defense.

Professor Robnett is a member of the National Association of Cost Accountants, Boston Chapter, and has been a director of that organization since 1937. He served as its president in 1944–1945. He is also a member of the American Accounting Association and of the Chamber of Commerce of Cambridge.

Campus Room Adieu

THE 289th dinner meeting of the Alumni Council, and the last scheduled to be held in the Campus Room of the M.I.T. Graduate House, was called to order on April 28 by Alfred T. Glassett, '20, President of the Alumni Association. With 122 members and guests present, Mr. Glassett announced that future meetings would be held in the Faculty Club in the Sloan Building, and expressed appreciation of the cordial hospitality extended by the management of the Graduate House for the past several years.

Donald P. Severance, '38, Alumni Secretary, reported that a budget for $36,595 for the fiscal year 1952–1953 had been reviewed by the Committee on Audit and Budget and approved by the Executive Committee which also appointed, for the following year, H. E. Lobdell, '17, as Executive Vice-president, Mr. Severance as Secretary and Treasurer, Henry B. Kane, '24, as Director of the Alumni Fund, and Madeline R. McCormick, as Assistant Treasurer.

During April, 10 members of the Institute's Faculty and staff visited 12 alumni clubs from Albany to Honolulu. A new club was formed on April 21 in Scranton, Pa., when the M.I.T. Club of Northeastern Pennsylvania held its organization meeting. Nominations submitted by the Committee on Nominations for Departmental Visiting Committees were also read, and, as another point of business, Mr. Kane reported that 6,800 Alumni had contributed $152,000 in the current year to the Alumni Fund.

Albert F. Sise, chairman of the Faculty Club's House Committee, spoke on facilities which the new club quarters would offer upon opening on May 7.

President Killian introduced Professors Ralph E. Freeman, Head of the Department of Economics and Social Science, and Erwin H. Schell, '12, Head of the Department of Business and Engineering Administration. After mentioning briefly the part these two men and their Departments were playing in the genesis of the School of Industrial Management, Dr. Killian presented E. P. Brooks, '17, Dean.

In speaking on plans for the School of Industrial Management, Dean Brooks pointed out three important advantages which came to the new School. First of all, the Sloan Foundation had made available an excellent building to house the School, and had made a grant of $1,000,000 to encourage research in the field of management. In addition, the environment of M.I.T. with its extensive background in engineering and science was propitious for developing the new School. Finally, the Course in Business and Engineering Administration, already with an outstanding record of achievement, would become the undergraduate element of the new School.

In anticipation of opening the new School in the fall of this year, an advisory council was established to assist in developing policies and long-range plans.

Investigations are currently being made in three broad areas as a means of crystallizing long-range planning for the School. Since industrial management is largely concerned with problems of distribution, efforts are being examined of the best methods of teaching this topic on a functional basis rather than dealing with individual products. Another fundamental question to be answered is how best to give courses in engineering and science to those planning to enter the field of management. Finally, the best means must be found to teach students of industrial management the social studies through development of fundamentals, rather than by exposure to a conglomeration of individual and disconnected topics.

Brown Heads Course VI

THE appointment of Professor Gordon S. Brown, '31, as Head of the Department of Electrical Engineering, has been announced by James R. Killian, Jr., '26, President. As Associate Head since 1950, Professor Brown has shared administrative responsibility of the Department of Electrical Engineering with Professor Harold L. Hazen, '24. He succeeds Professor Hazen who will become dean of the Graduate School on July 1, upon the retirement of John W. M. Bunker.

Born in New South Wales, Australia, in 1907, Professor Brown received the diploma of mechanical and electrical engineering in 1925 from the Melbourne Technical School. From M.I.T. he received the degree of bachelor of science in 1931, the master's degree in 1934, and his doctorate in 1938. He joined the Department of Electrical Engineering in 1931 as research assistant, was appointed assistant professor in 1939, associate professor in 1941, and became professor of electrical engineering in 1946.

Professor Brown's work at the Institute, for which he is internationally known, has been devoted to the development of measurement and control devices. Prior to World War II he was engaged in the design and construction of the cinema integraph and an automatic curve follower. He was appointed director of the servomechanisms study at the Institute in 1941 when the Institute had the only university servomechanisms laboratory in the nation. At the outbreak of World War II, Dr. Brown and his colleagues immediately undertook a program of research for the armed services that contributed notably to successful operations against the enemy. Since the end of World War II, the Institute's Servomechanisms Laboratory, which Dr. Brown headed, has been engaged in research on important industrial problems, including the design and construction of control mechanisms for the Brookhaven National Laboratory, automatic controls for a chemical manufacturing plant, and a precision-controlled milling cutter.

Professor Brown was consultant to the National Defense Research Committee, and a special consultant on fire control for the War Department during World War II. For his contributions to national research problems during the war, he received the Presidential Certificate of Merit in 1948.

Professor Brown is coauthor, with Albert C. Hall, '37, of a volume on *Dynamic Behavior and Design of Servomechanisms* and, with Donald P. Campbell, '43, Associate Professor of Electrical Engineering, of another book entitled, *Principles of Servomechanisms*. In addition, he is author of a number of technical papers in engineering and scientific publications.

M.I.T. Photo

Professor Gordon S. Brown, '31
Head of the Department of Electrical Engineering

L. J. Chu, '35 | K. W. Deutsch | A. E. Fitzgerald, '31 | M. F. Millikan | A. H. Shapiro, '38

M.I.T. Photos

Professorial Progress

PROMOTIONS on the Faculty of the Institute which will become effective July 1 include nine who become professors, 13 who are advanced to associate professor, 26 new assistant professors, and nine instructors.

Members of the staff promoted to the rank of full professor are: John C. Sheehan and Walter H. Stockmayer, '35, both of the Department of Chemistry; Max F. Millikan, Department of Economics and Social Science; Lan Jen Chu, '35, Arthur E. Fitzgerald, '31, and John G. Trump, '33, all of the Department of Electrical Engineering; Karl W. Deutsch, Department of English and History; Ascher H. Shapiro, '38, Department of Mechanical Engineering; and Howard F. Taylor, 2–46, Department of Metallurgy.

Assistant professors promoted to the rank of associate professor are: Thomas M. Hill, Department of Business and Engineering Administration; T. William Lambe, 2–44, Department of Civil and Sanitary Engineering; George C. Newton, Jr., '41, and William M. Pease, '42, both of the Department of Electrical Engineering; Thomas H. D. Mahoney and Theodore Wood, Jr., both of the Department of English and History; Ernest E. Lockhart, '34, Department of Food Technology; August L. Hesselschwerdt, Jr., '31, Brandon G. Rightmire, '41, and Warren M. Rohsenow, all of the Department of Mechanical Engineering; J. Harvey Evans, Department of Naval Architecture and Marine Engineering; and Bernard T. Feld and David H. Frisch, '47, both of the Department of Physics.

Promotions to the rank of assistant professor are: Roland F. Beers, Jr., '51, Department of Biology; Cyril C. Herrmann and Robert G. James, both of the Department of Business and Engineering Administration; George B. Baldwin, '50, and Mrs. Elspeth D. Rostow, both of the Department of Economics and Social Science; Charles W. Adams, '48, Ernest J. Angelo, Jr., '49, and Rudolph J. Cypser, all of the Department of Electrical Engineering; Leslie H. Fishel, Jr., Robert L. Koehl, James G. Kelso, and Arthur Mann, all of the Department of English and History; Samuel A. Goldblith, '40, and John T. R. Nickerson, '32, both of the Department of Food Technology; William H. Dennen, '42, Department of Geology; George H. Allen, '48, and Steven A. Coons, '32, both of the Section of Graphics; John A. Clark and Stephen J. Kline, I-Ming Feng, Erwin G. Loewen, '49, Tau-Yi Toong, '48, and J. Lowen Shearer, '50, all of the Department of Mechanical Engineering; Clyde M. Adams, Jr., '49, and Earle R. Marshall, '48, both of the Department of Metallurgy; and George E. Condoyannis, Department of Modern Languages.

J. C. Sheehan
W. H. Stockmayer, '35
H. F. Taylor, 2-46
J. G. Trump, '33

New appointments include Jan R. Schnittger who will be assistant professor in the Department of Aeronautical Engineering.

Members of the staff advanced to the rank of instructor include: William L. Maini, '51, Department of Building Engineering and Construction; André R. Barbeau, Harold S. Oakes, Jr., Orville D. Page, and William A. Youngblood, all of the Department of Electrical Engineering; Phineas Alpers, Section of Graphics; Donald R. Walker, '50, Department of Mechanical Engineering; Frederick Sanders, Department of Meteorology; and George W. Clark, Department of Physics.

Appointments with the rank of instructor include: Herbert M. Voss, '50, Department of Aeronautical Engineering; and Iain Finnie, '50, Department of Mechanical Engineering.

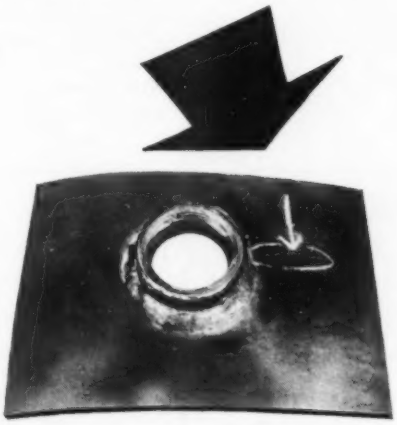
C. B. Biezeno, Professor of Applied Mechanics at the Technical Institute of Delft, Holland, has been appointed visiting professor of mechanical engineering for the 1952 fall term.

(*Concluded on page 430*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

This might be called "The Case of the Mysterious Mercury." It is reported because the solution provides an interesting example of the value of industrial research. A Revere customer who makes tanks of Herculoy reported that one of them had developed a serious crack about two inches long, and thought it must be due to a defect in the metal. Herculoy is a silicon bronze with the corrosion resistance of copper plus the strength of mild steel. It is exceptionally easy to weld by standard commercial methods, yet the crack occurred adjacent to the weld at the tank fitting.



Herculoy has many admirable qualities, which lead to its specification for a wide variety of products. We seldom hear reports of difficulties with it, and such cases upon investigation usually turn out to be the result of failure to follow the quite simple requirements for successful fabrication, requirements which any properly-equipped shop can meet. However, this crack in the tank, occurring in the plant of an experienced fabricator, did not fall in any usual pattern. So we asked that a section, including the weld and the crack, be sent to Revere Research Department for study.

Visual inspection showed no clear-cut reason for failure. A specimen cut through the weld was uninformative, except that the weld was good. Another micro-section cut through the crack put us on the trail. There was a silvery-gray material between the grains of the metal, resembling neither the Herculoy or the weld metal. In fact, it seemed to be a liquid, which had followed the grain boundaries and thus had caused the crack. When the crack itself was broken open and examined under the microscope, some small beads of liquid could be seen. These were positively identified as mercury. This metal is a very useful one, but it is destructive to copper and copper alloys, and should never be allowed to touch them. In fact, some other metals in liquid form, such as solders and brazing metals, can be corrosive if temperatures are too high or maintained too long. It is a tribute to American craftsmanship that processes such as soldering, tinning and brazing are practically always accomplished without damage to the base metal.

We have had a number of cases in which mercury caused difficulty, but this time the source of the mercury could not be determined. The most logical supposition is that a mercury thermometer fell on the tank, but nobody knows for sure. However, we and our customer now know that mercury caused the crack, and that instruments containing mercury should be used with care around copper and copper alloys.

This is just one instance of the work of Revere Research, which operates a well-staffed and equipped laboratory. There are many such laboratories, in every industry, each concerned with the practical solution of problems in manufacture, specification, and use of materials. So, we suggest that if you encounter a mystery in materials it will pay you to get the facts from your supplier's laboratory.

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THE INSTITUTE GAZETTE

(*Concluded from page 428*)

Speech Sounds Studied

THE Visiting Committee on the Department of Modern Languages* met on November 2, 1951. The following members were present: Messrs. Cooper, Cowan, Russell, and Carlson. Senator Flanders, Mr. Loomis and Father Walsh were unable to attend. Father Walsh, at the suggestion of the chairman, sent a substitute, Leon Dostert, Director of the Georgetown University Institute of Languages and Linguistics in Washington.

The program began with visits to classes and laboratories throughout the morning. After a lunch with the members of the Department staff the meeting proper took place, with reports on the work the staff is doing and the philosophy by which they are guided in their activities.

The work of the Department can be divided into three types: elementary and intermediate language teaching, with acquisition of some facility in speaking or reading and an understanding of the mechanism of language as goals; advanced language and literature, where more mature students are given a broader linguistic background or a feeling for the thought and life of a foreign country; and research on language, that is, the study of language as a branch of the science of communication.

Research on the nature of speech sounds is being carried on by three members of the Department, two of whom are on a full-time basis and one on half time. Little is known at present about the characteristics by which speech sounds are identified or discriminated by the hearer. Both analysis and synthesis are being used to cast light on this problem: analysis, through the study of the frequency spectrum of various sounds and the study of the transitions between sounds; synthesis, in an attempt to make human-sounding speech sounds artificially, using the data which analysis of their frequency spectrum reveals.

Present results indicate that solutions are near. The implications of such solutions would be very great, not only for the teaching of speech but also for the branch of science and engineering dealing with speech.

One other research project in a different area has been under the administration of the Department of Modern Languages for the last two years. This is the work of J. Whitney Perry, '31, on classifying, coding, storing, and finding information with a view to use with mechanized data-handling equipment both existing and future.

*Members of this Committee for 1951-1952 are: Harry J. Carlson, '92, chairman, Robert P. Russell, '22, Franklin S. Cooper, '36, J. Milton Cowan, Ralph E. Flanders, Alfred L. Loomis, and Father Edmund A. Walsh, S.J.

Class Reunions

Plans for class reunions and get-togethers, to be held in conjunction with Alumni Day on Monday, June 9, and on other dates, are being formulated. The dates and places given below have been selected by the classes here listed whose members expect to hold gatherings this June.

1892 June 7. Luncheon to be held near Boston. Charles E. Fuller, reunion chairman, Box 144, Wellesley 81, Mass.

1897 June 10. Luncheon at 1:00 P.M. at Algonquin Club, Boston. Special Class table at luncheon in Great Court on Alumni Day. John A. Collins, Jr., reunion chairman, 20 Quincy Street, Lawrence, Mass.

1900 June 10–12. The Pines, Cotuit, Mass. Elbert G. Allen, Secretary, 11 Richfield Road, West Newton 65, Mass.

1902 June 6–8. 50th reunion at Coonamessett Ranch Inn, North Falmouth, Mass. Claude E. Patch, reunion chairman, 862 Park Square Building, Boston 16.

1907 June 20–22. Oyster Harbors Club, Osterville, Mass. Bryant Nichols, reunion chairman, 23 Leland Road, Whitinsville, Mass.

1912 June 6–8. Snow Inn, Harwichport, Mass. Albion R. Davis, 11 Vane Street, Wellesley 81, Mass., and Ernest W. Davis, 6 Chapman Street, Arlington 74, Mass., are the reunion cochairmen.

1916 June 6–8. Coonamessett Ranch Inn, North Falmouth, Mass. Ralph A. Fletcher, Secretary, P. O. Box 71, West Chelmsford, Mass.

1917 June 6–8. Wentworth by-the-Sea, Portsmouth, N.H. Stanley C. Dunning, reunion chairman, 105 Irving Street, Cambridge 38, Mass.

1921 June 9. Class get-together in afternoon at Hotel Statler on Alumni Day.

1922 June 6–8. Sheldon House, Pine Orchard, Conn. Raymond C. Rundlett, reunion chairman, 6 Vine Street, Bronxville, N. Y.

1923 June 9. Class get-together at 5:00 P.M. at Hotel Statler on Alumni Day.

1925 June 9. Class get-together at 4:00 P.M. at Hotel Statler on Alumni Day.

1927 June 6–8. 25th reunion at Oyster Harbors Club, Osterville, Mass. Glenn D. Jackson, Jr., reunion chairman, 54 Lenox Road, Summit, N. J.

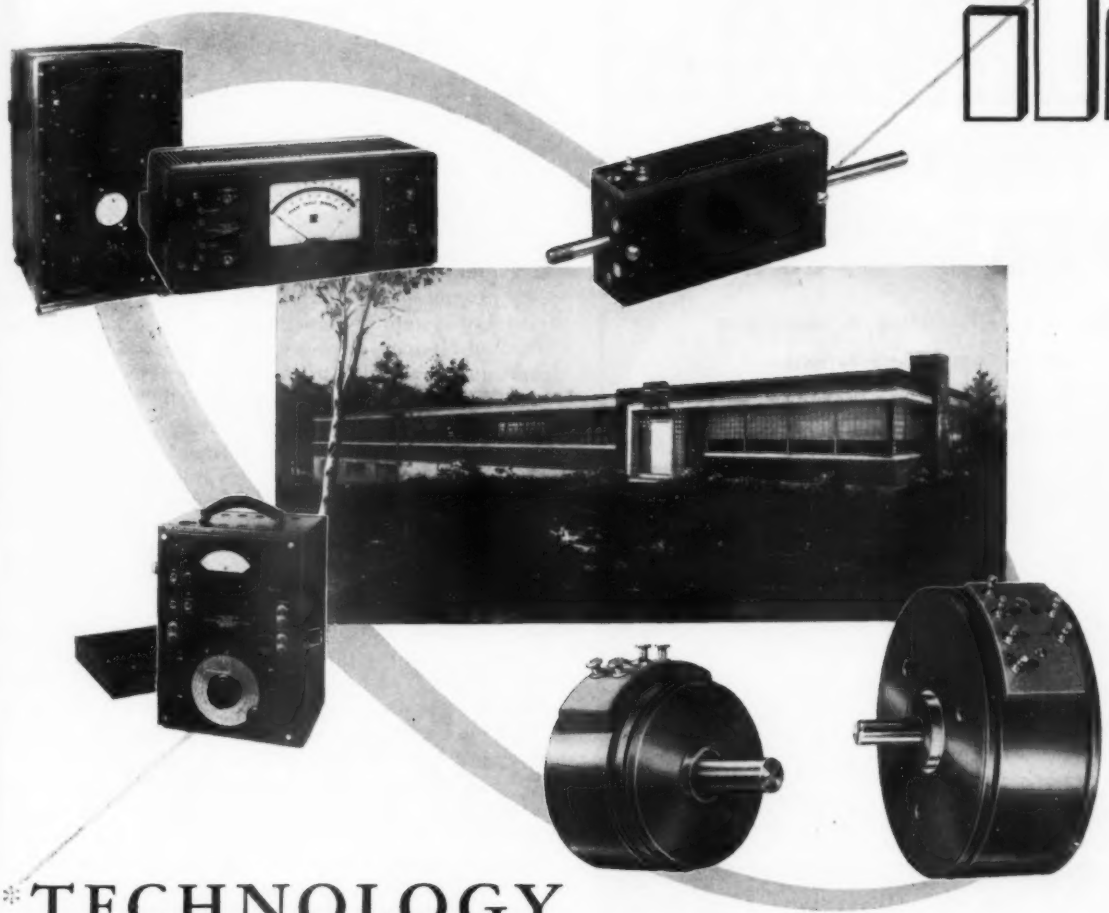
1932 June 6–8. Curtis Hotel, Lenox, Mass. Thomas E. Sears, Jr., reunion chairman, Park Square Building, 31 St. James Avenue, Boston 16.

1937 June 6-9. Weekapaug Inn, Weekapaug, R. I. Philip H. Peters, reunion chairman, 14 Cushing Road, Wellesley Hills 82, Mass.

1942 June 7–8. Hotel Griswold, New London, Conn. Charles A. Speas, reunion chairman, 17 Crown Ridge Road, Wellesley 81, Mass.

1947 June 6–8. Cliff Hotel, Scituate, Mass. James L. Phillips, reunion chairman, Masconomo Street, Manchester, Mass.

For additional information and the latest details please consult the class secretary or the reunion chairman, so that you may make satisfactory arrangements for attendance at your reunion.



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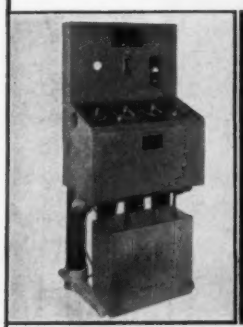

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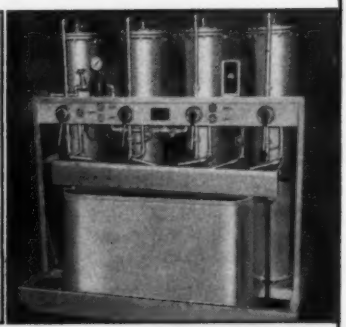

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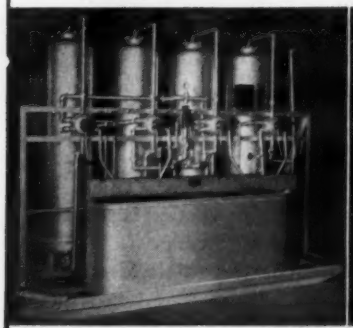

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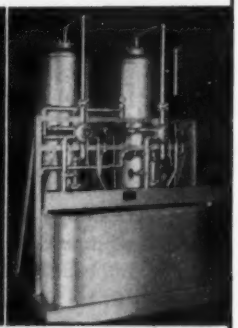

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UNIFORM INTERNATIONAL COINAGE, 1863–1869

(*Continued from page 425*)

Powers . . . to promote the adoption . . . of a common unit and standard of an international gold coinage. . . ."[26]

The Senate acted favorably and in due time Secretary of State Fish made the requested inquiries, but before he did certain events in the House modified his action. William D. Kelley, congressman from Philadelphia, on February 7, 1870, introduced a bill "to promote the establishment of an international metrical system of coinage" and about a month later Samuel Hooper, Representative from Massachusetts, introduced a bill "to promote international coinage."[27] Both bills were referred to the Committee on Coinage, Weights, and Measures. Hooper's bill largely followed Sherman's in the Senate, which embodied Ruggles' ideas. Kelley's bill followed a radically different plan and represents one of the main rocks on which the proposition of international coinage foundered in Congress. It provided for a gold dollar of exactly one and one half grams of gold, thereby suiting the metrical purists; this coin to be the standard, a stipulation which pleased those who believed that the dollar should be "almighty" in the world as well as in America. He criticized the American representative for not upholding the dollar at Paris and then in a polemic that dodged the main issues argued that more people did not, than did, use the franc and that the population of America was increasing faster than that of France. This was all very true, but as later speakers pointed out had little bearing on the subject. He also showed that his new dollar would blend perfectly with many of the German currencies, and made such a point of this fact that his system became known as the German scheme, as opposed to Ruggles' French scheme.[28] Replies to Kelley were delivered by Hooper and Clarkson N. Potter, a New York congressman. Hooper demonstrated that Kelley's measure would require both the British and the Latin Union to raise the gold content of their currencies to an appreciable extent, though it was notoriously more difficult and inconvenient for a country to raise the bullion content of its coinage than to lower it; and that, moreover, no other nation had ever agreed to this scheme, while Ruggles' plan, whatever its failings, had been agreed to in principle by representatives of all the principal nations. He dismissed the even weight idea as of no importance, since coins were not used as weights. Potter supported Ruggles' idea and quoted the really important statistics on the world's gold coinage:

Amount of Current Gold Coinage

Nations using or agreeing to the franc	$1,450,000,000
Nations using or agreeing to the pound	450,000,000
Nations using or agreeing to the dollar	200,000,000
Nations using or agreeing to other currencies	300,000,000

(*Continued on page 434*)

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UNIFORM INTERNATIONAL COINAGE, 1863 - 1869

(Continued from page 432)

Moreover, he pointed out that the United States had no specie in circulation, while the five-franc gold piece was used in many countries that did not officially adhere to the franc.[29, 30]

In June, Fish proceeded to communicate with the foreign governments in accordance with the resolution of the Senate of February 8. It is significant that George Bancroft, the noted historian, our Minister to Prussia, in acknowledging the circular from Berlin, should write, "The tendency here is strong toward the adoption of the five and twenty-franc gold piece."[31] But all these efforts proved sterile. In any event the Franco-Prussian War would probably have put an end to the attempt at a monetary union on the basis of the franc, although if standardization had taken place in 1868 it might have survived the war. The gold standard which the International Monetary Conference of 1867 enthusiastically supported was shortly adopted by the nations of continental Europe most of whom had been on a bimetallic or silver standard. The American representative at the conference was one of the strongest supporters of the gold standard which is interesting in view of the terrific political fight that ensued a few years later before gold became the official standard in the United States. The New York *Times* of July 9, 1867, commented editorially on the work of the Congress, "Whether we shall ever accept this standard or not it is unquestionably as good a one as it is possible to choose."

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(Concluded on page 436)

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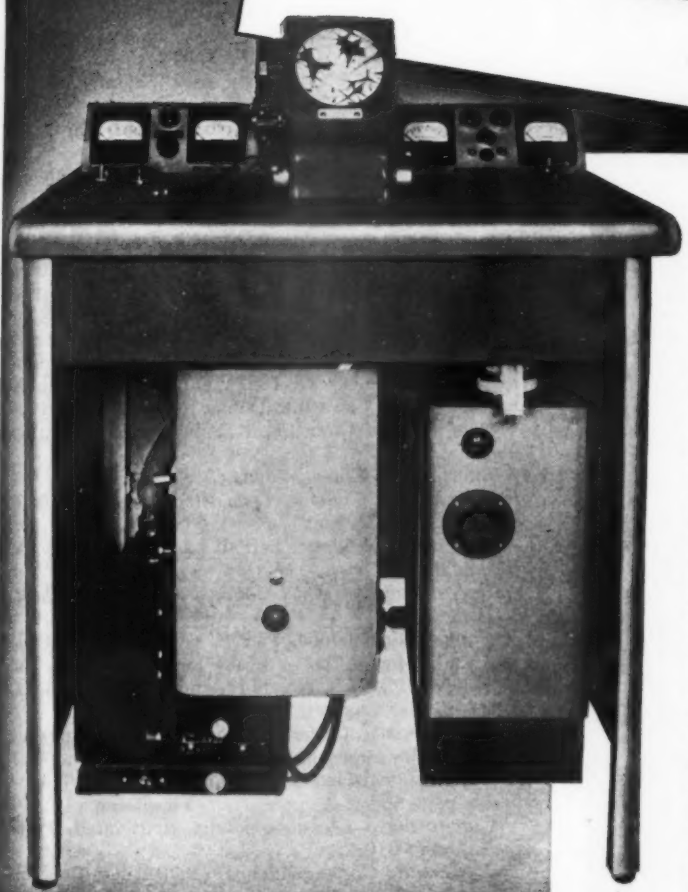

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UNIFORM INTERNATIONAL COINAGE, 1863 - 1869

(Concluded from page 434)

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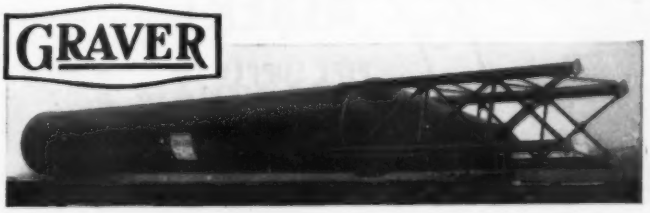

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OF YANKEE GRANITE

(*Continued from page 422*)

Every four courses of the wall stones (about 11 feet) the derrick was raised, perhaps by unshipping the boom and using it as a lesser mast to raise the mast proper. Square timber sticks were then beginning to be used for staging, instead of the round trunks of small trees and saplings previously used. A sketch of the monument shows a squared timber stage for pointing the joints. Such a stage could be much more easily erected, and was more reliable than the round sticks, tied at the joints by cords.

On paper, Willard had performed the painstaking task of dimensioning every stone, each with its top (the build) a little narrower than its bottom (the bed), so that the true taper of the obelisk would be maintained. To set the stone to line was the chore of the erecting force. On the top of the stone already in place lime mortar was spread, enriched with hydraulic cement, and with a sprinkling of iron filings. (A popular, modern, commercial waterproofing compound utilizes the fact that, upon oxidizing, iron particles mixed with the cement mortar expand, thus reducing the voids and producing a denser mass when the mortar sets.)

Temporary wooden wedges would be placed at the corners of the stone already in place, to support the heavy new stone until the mortar had hardened. When the ponderous stone had been speedily raised from the ground to a level a few inches above the mortar, the engine would be stopped; the derrick adjusted to right or left, and in or out, until the stone was very closely in line. Next, riggers would push on the bridle chain which attached to the two lewises in the stone's top surface, guiding it to its true position in its gentle descent as the engine lowered it the few inches needed to bed it. A tiny fraction of an inch "out-of-line" would be serious, for such errors if repeated, or if not compensating, would visibly throw the monument out of line. On a light stage high above the ground, bracing themselves against gusts of wind, the riggers would be intent on the necessity for such accuracy, but not forgetting their own safety, for no careless workman could work for Savage. They would remember that, while laying the last stone of the 12th course, at the southwest corner, one man had been pushed off (the only death on the project).

Profitable Project

Happily, the good riggers raised their monument, course by course, to the top. They were under a boss who knew his trade, and he was making money – the sign of content on any construction project. (Savage made some more money after the monument was finished, when he retained the steam engine that had been used for hoisting stone, for the purpose of raising a passenger car to the top. For the car ride he collected $0.20, as against the $0.125 for visitors who climbed the stairs.)

The practical riggers would not be disturbed at the proposal, advanced when the monument neared

(*Continued on page 440*)

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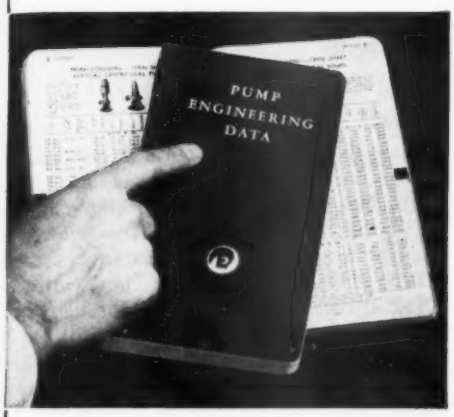

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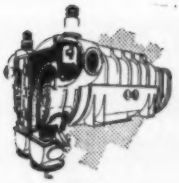

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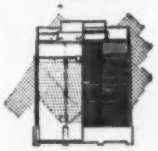

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OF YANKEE GRANITE

(*Continued from page 438*)

its top, that the apex be modified to form a platform to accommodate visitors. Aesthetic Bostonians were much disturbed at this proposal. Happily, the Bunker Hill Monument Association voted down this architectural atrocity.

High Capstone

On Saturday, July 23, 1842, several hundred of our early rising Bostonian ancestors rose earlier than usual to arrive at the monument at 6:00 A.M. On the ground at the base, they studied the capstone; a small stone pyramid, three feet, six inches high, stoutly lashed to the derrick hook, and with an American flag at the top. Standing on the capstone, firmly grasping the hoisting rope, Colonel Charles R. Carnes waited for the signal to hoist. When the clock struck six, a signal gun was fired, and the capstone, bearing the good colonel, started up. In 16 minutes it had reached the top; at 6:30 A.M. it had been bedded, and a national salute announced to all Boston that the Bunker Hill Monument was completed.

By railroad, great multitudes came to Boston for the dedication of the Bunker Hill Monument, nearly a year later, on June 17, 1843. Unlike the time of 18 years earlier, when the cornerstone had been laid, stagecoaches were not the main conveyance for visitors to Boston. Indeed they were decidedly on the way out, and would soon be but symbols of an era of traveling discomfort, as the railroad completely took over. President Tyler and his cabinet attended; Daniel Webster matched with sonorous eloquence his famous speech at the laying of the cornerstone, and there were still 13 very aged surviving veterans of the battle able to attend.

Foucault's Experiment

Seven years later (1850), two Harvard professors checked with elaborate apparatus, paid for by members of the Bunker Hill Monument Association and the Massachusetts Charitable Association, the famous experiment of Foucault which used a long pendulum to prove the daily rotation of the earth. Suspended in the newel by an annealed wire, 210

(*Continued on page 442*)

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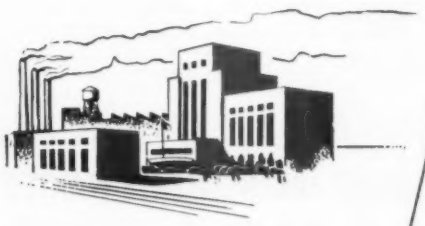

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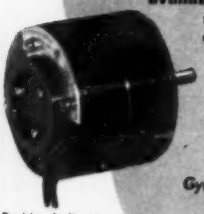

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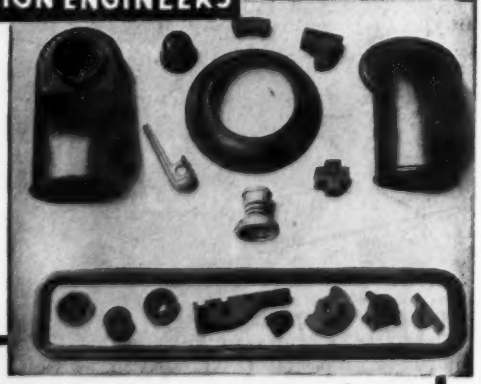

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OF YANKEE GRANITE

(*Continued from page 440*)

feet long, the oscillations of a pointer, attached to a 31-pound British cannon ball relic of the battle, were observed; and its plane of swing was seen to revolve during the day from right to left of the observer. A sudden shower on a previously bright day complicated the experiment, until Professor Eben N. Horsford discovered the reason. Cooled by the rain the monument's exposed face contracted; its apex moved correspondingly and carried the point of suspension of the pendulum with it. As observed years later on the Washington Monument, Horsford deduced that the side of an obelisk, exposed to the hot sun, expanded, and that its apex followed the sun in the sun's travel from east to west. Such motion is tiny, and the ingenuity of the apparatus to observe it was notable. The path of the orbit of the bob, registering both the earth's rotation and the effect of varying heat on the monument's sides, was described as an irregular ellipse with a major axis of one-half an inch.

Today

Two hundred thousand persons visit Bunker Hill every year. Of these visitors 20,000 pay their $0.10, and presumably climb the 294 granite steps to the top.[11] Very few Bostonians are among these visitors.[12] They are of various types: honeymooners and casual tourists, whose list of the sights to be seen in historic Boston includes the monument, and historically minded youngsters, one of whom was recently caught in a heated argument with his father as to where the order was to "wait 'til you can see the whites of their eyes." Surely, the stout young man who recently lugged 25 pounds to the top – his young daughter – was not typical.

The evidence that the monument is probably the most popular of the historic shrines of old Boston would be as pleasing to the charter members of the Bunker Hill Monument Association as to the present members of this venerable society, which lists among present and past members, 30 generals, 12 admirals,

(*Continued on page 444*)

[11]Estimate of custodian from a review of his register, 1951.

[12]"Those pangs of conscience he feels every June 17 are as close as the average Bostonian ever comes to climbing Bunker Hill Monument." – *Boston Globe*, June 18, 1951.

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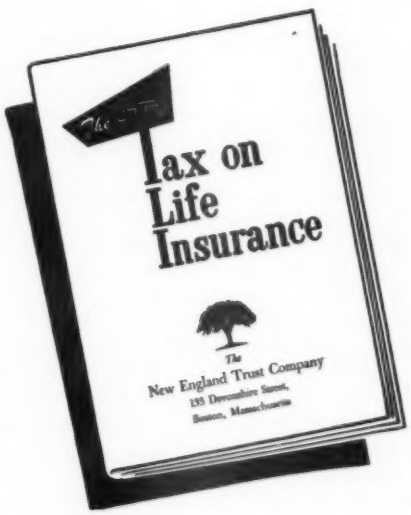

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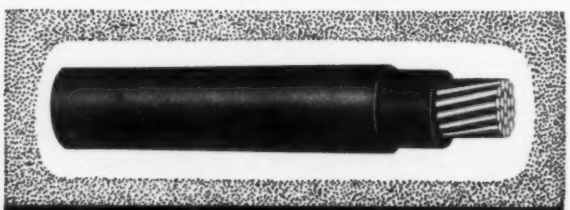

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OF YANKEE GRANITE

(*Continued from page 442*)

12 Presidents of the United States, a score of Massachusetts governors, 20 mayors of Boston, and 6 presidents of Harvard University. It is a healthful society to belong to, the 1949 *Proceedings* say, in the mention of 46 half-century members of whom 16 were then living.

Many years ago, the Association voted to hold patriotic exercises every year at the monument, and this resolution has been faithfully fulfilled. The annual ceremonies today are very different from those of the earlier years; they have followed the varying pattern in which American citizens have celebrated their national anniversaries during the more than a century since the monument was dedicated in 1843. They were solemn occasions during the earlier years. In what better spot could the Yankees of the trying days of the Civil War compare their convictions with those who fought for similar principles, than at the monument, as they listened to the stirring eloquence of their War Governor, John A. Andrew. In later years the holiday spirit took over, with a fireman's muster to please the older folk, while the youngsters of Greater Boston made Bunker Hill Day on June 17 a parallel in firecracker noise and casualties to fingers and eyesight, to the Fourth of July, of which it was a preview. Today, Bunker Hill Day is a huge neighborhood festival, with block parties and a skillfully routed parade which seems to pass every house on the hill. They who enjoy things most are the children of working people, not of the wealthy families that once lived in the sightly dwellings of Bunker Hill. Each boy or girl can give a visitor the story of the battle in detail, and recite the precise dimensions of the monument. (They collect from tourists for this information, for it is one way by which Charlestown

(*Concluded on page 446*)

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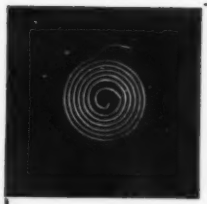

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OF YANKEE GRANITE

(*Concluded from page 444*)

youngsters get their spending money.) These children would rarely answer to the old names: Prescott, Warren, Putnam, or similar Yankee names. They are mostly of second or third generation European families: proud Americans, fortunate to live near the site of one of America's most famous historical shrines. Their festival is a heartening occasion to witness, for it is American democracy at its best.

Through it all the monument rises above its unadorned settings; except that the crown of the hill has been removed, it could still be the New England hilltop farm on which the battle was fought. The obelisk rises in the simplicity of its straight lines and clean angles, with no curves, and with the somber gray of its harsh-textured masonry unrelieved by any greenery of foundation shrubbery. The rugged monument is symbolic of the stern spirit of those who fought in the battle, and of the determination of those who solved the problem of building this massive memorial to them, in the pioneer days of American architecture and engineering.

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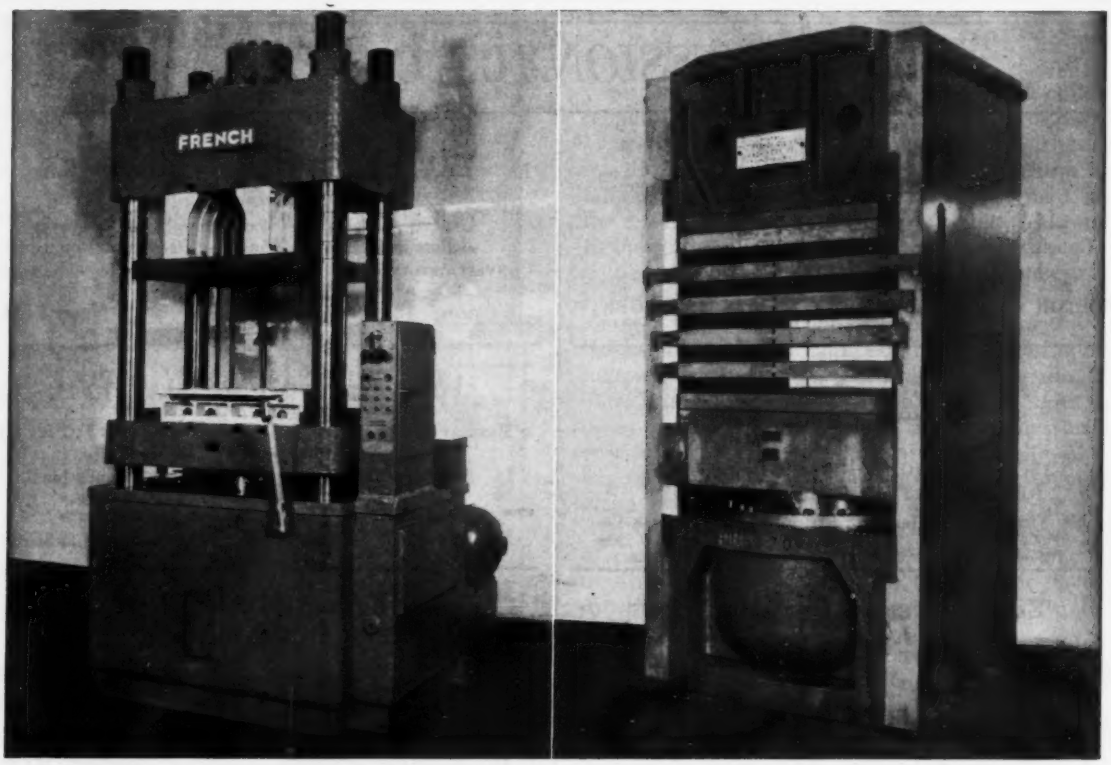

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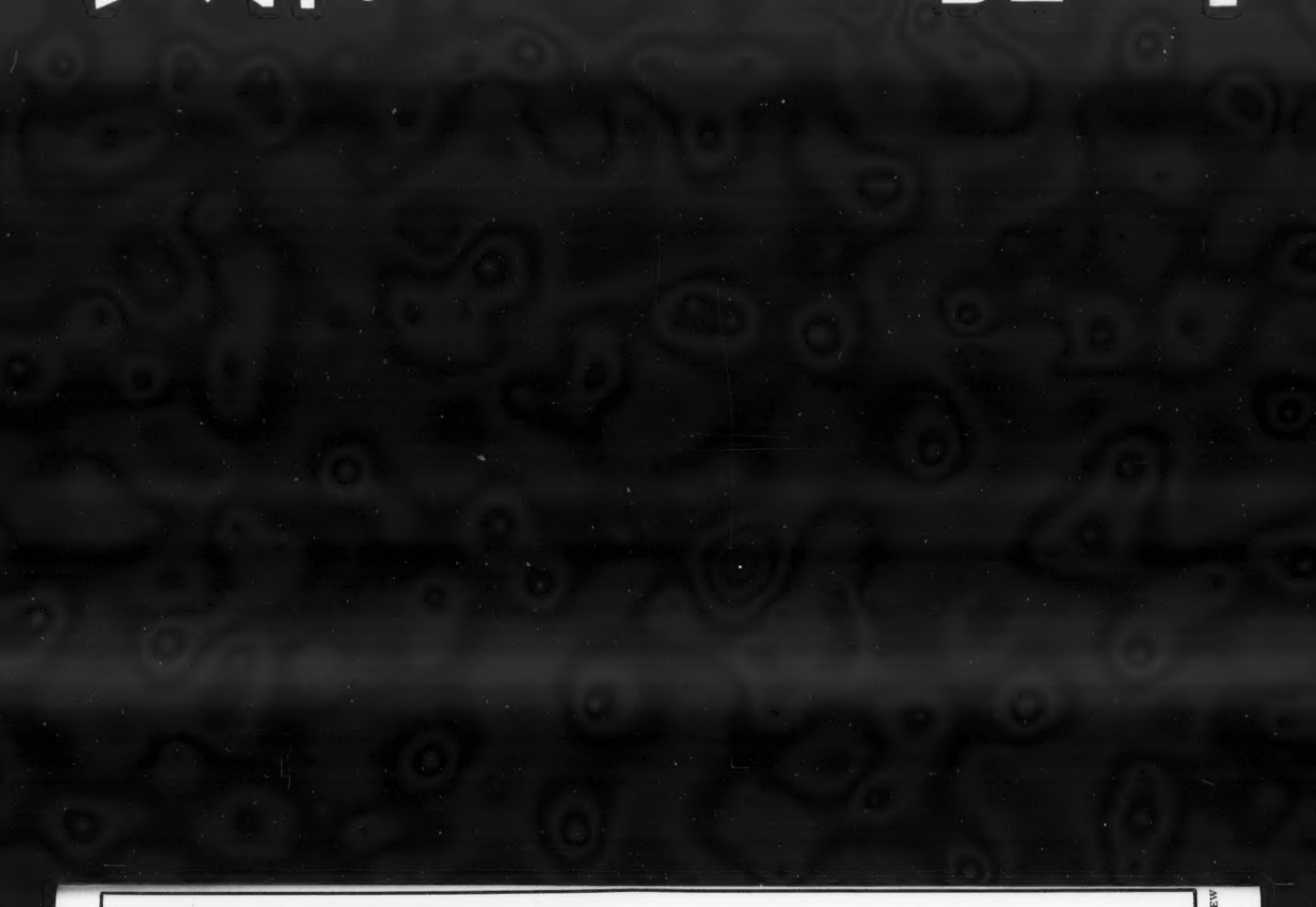
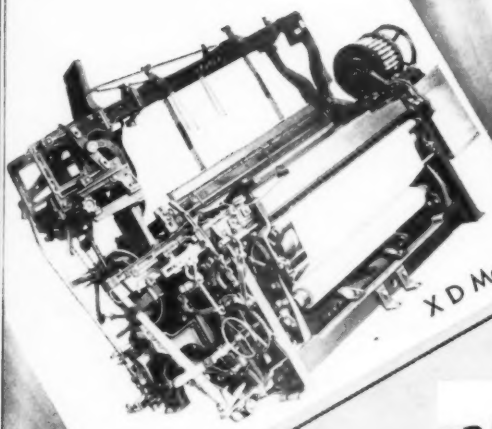
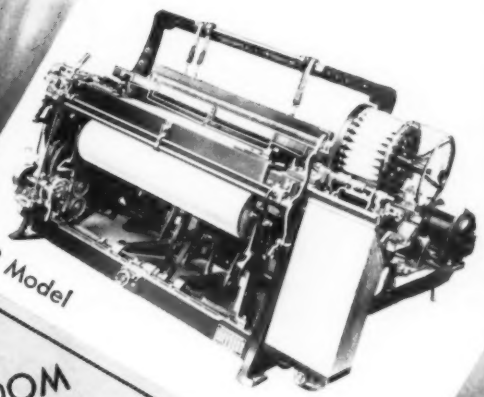




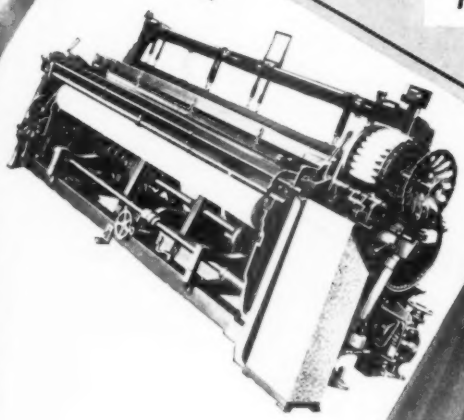
X D Model



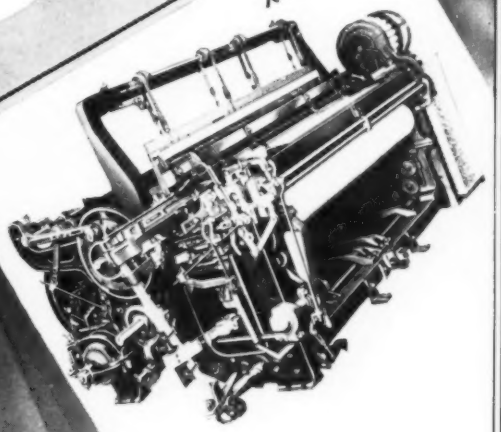
X 2 Model

THE DRAPER LOOM
PRODUCES MORE CLOTH
AT LESS COST

X L Model



X P Model



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Unusually Wide Frequency Range
Low Distortion Excellent Stability
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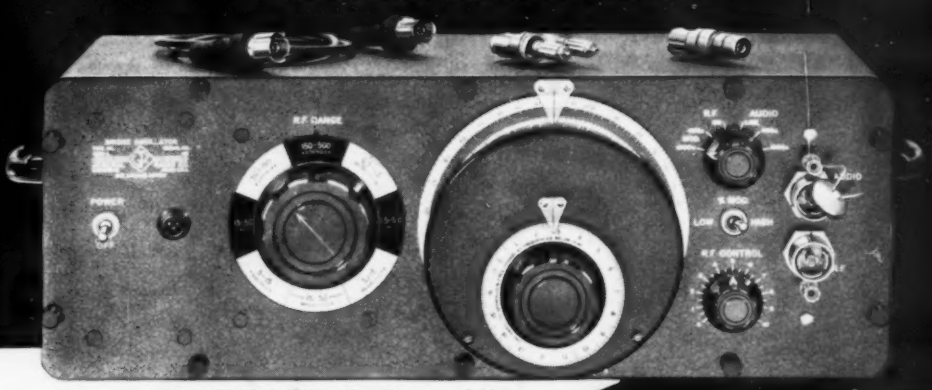
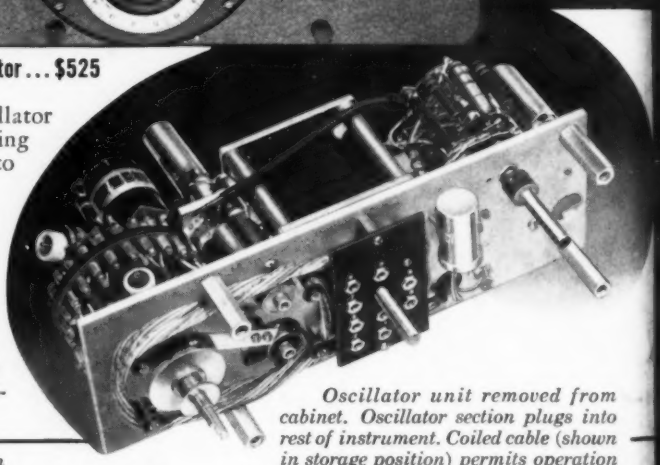


Type 1330-A Bridge Oscillator . . . $525

The General Radio Type 1330-A Bridge Oscillator is a compact variable frequency source providing power over a very wide range — from 5 kc to 50 Mc and at 60, 400 and 1000 cycles.

Switching permits internal modulation at 400 and 1000 cycles, at 30% or 60% modulation levels.

The stability and wide range of this oscillator ideally adapt it to bridge and antenna measurements. Low distortion, a maximum power output of one watt and many operating conveniences make this instrument a versatile general laboratory source.



Oscillator unit removed from cabinet. Oscillator section plugs into rest of instrument. Coiled cable (shown in storage position) permits operation and servicing of instrument while removed from cabinet.

WIDE FREQUENCY RANGE — *continuously adjustable from 5 kc to 50 Mc; 60, 400 and 1000 cycle fixed audio frequencies*

GOOD ACCURACY — *±2% for carrier frequencies above 150 kc; ±3% below 150 kc; ±5% at 400 and 1000 cycles*

RAPID FREQUENCY SETTING — *r-f tuning dial and range switch permit rapid and accurate frequency selection*

INCREMENTAL FREQUENCY DIAL — *vernier on tuning dial indicates 0.1% frequency increments of main dial division*

INTERNAL MODULATION — *400 or 1000 cycles at 30% or 60% levels*

ADEQUATE OUTPUT — *r.f. is 10 volts, open circuit; 1 watt into matching 50-ohm load — audio is 12 volts, open circuit, ¾ watt into matching 50-ohm load*

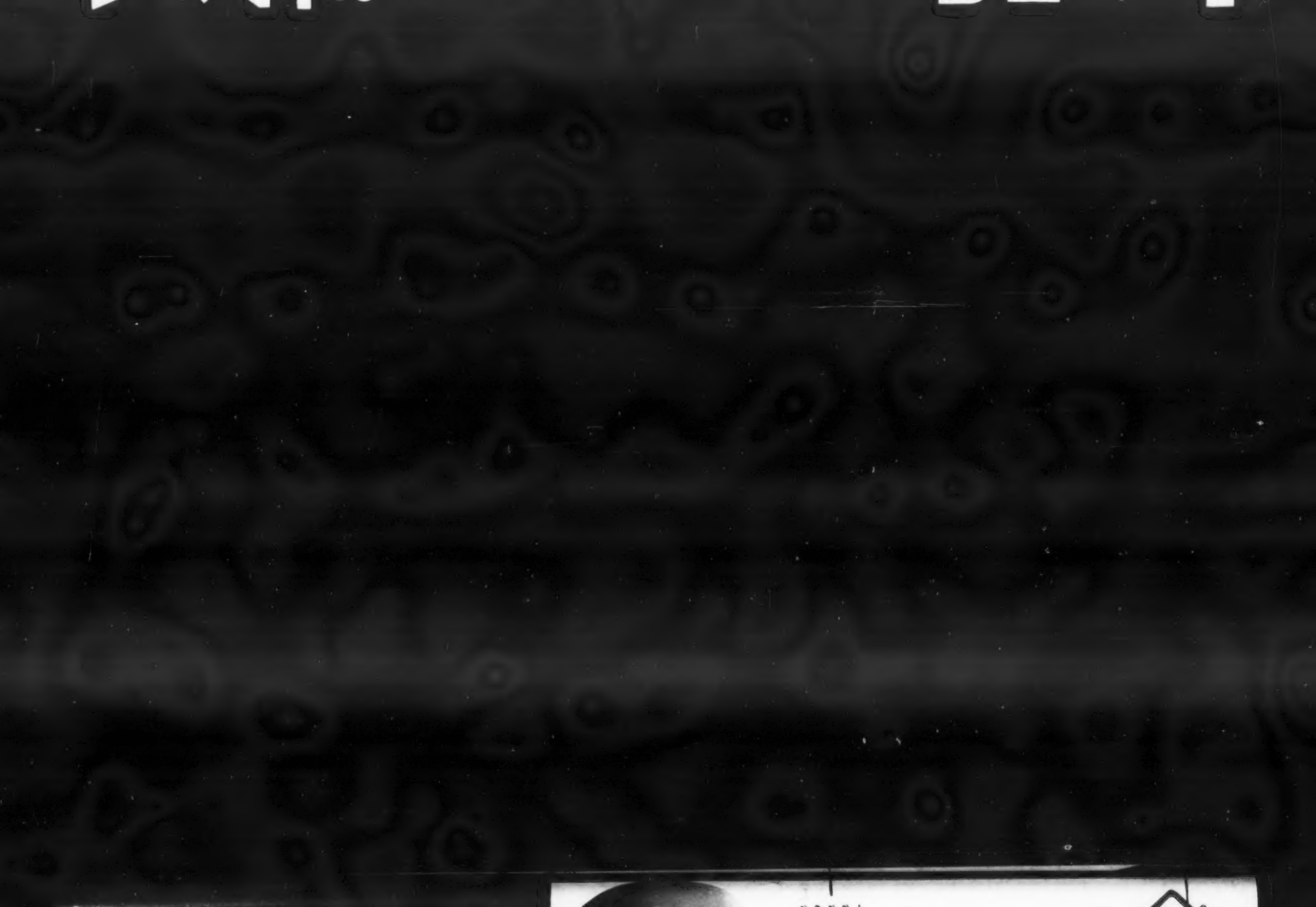
ADJUSTABLE OUTPUT — *attenuator for 5 kc–50 Mc range*

LOW DISTORTION — *r-f 3% over most of range; a-f approximately 5% at 400 cycles and at 1 kc; envelope distortion less than 6% at 60% modulation, 3% at 30% level*

LOW LEAKAGE — *r-f and audio circuits are in a shielded compartment within the main cabinet. Leads to plate and heater are filtered. At 1 Mc stray fields are about 50 μv per meter at two feet from instrument*

SHIELDED OUTPUT JACKS — *matching coaxial connectors, cables and adapters are provided for complete shielding of oscillator output.*

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts

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